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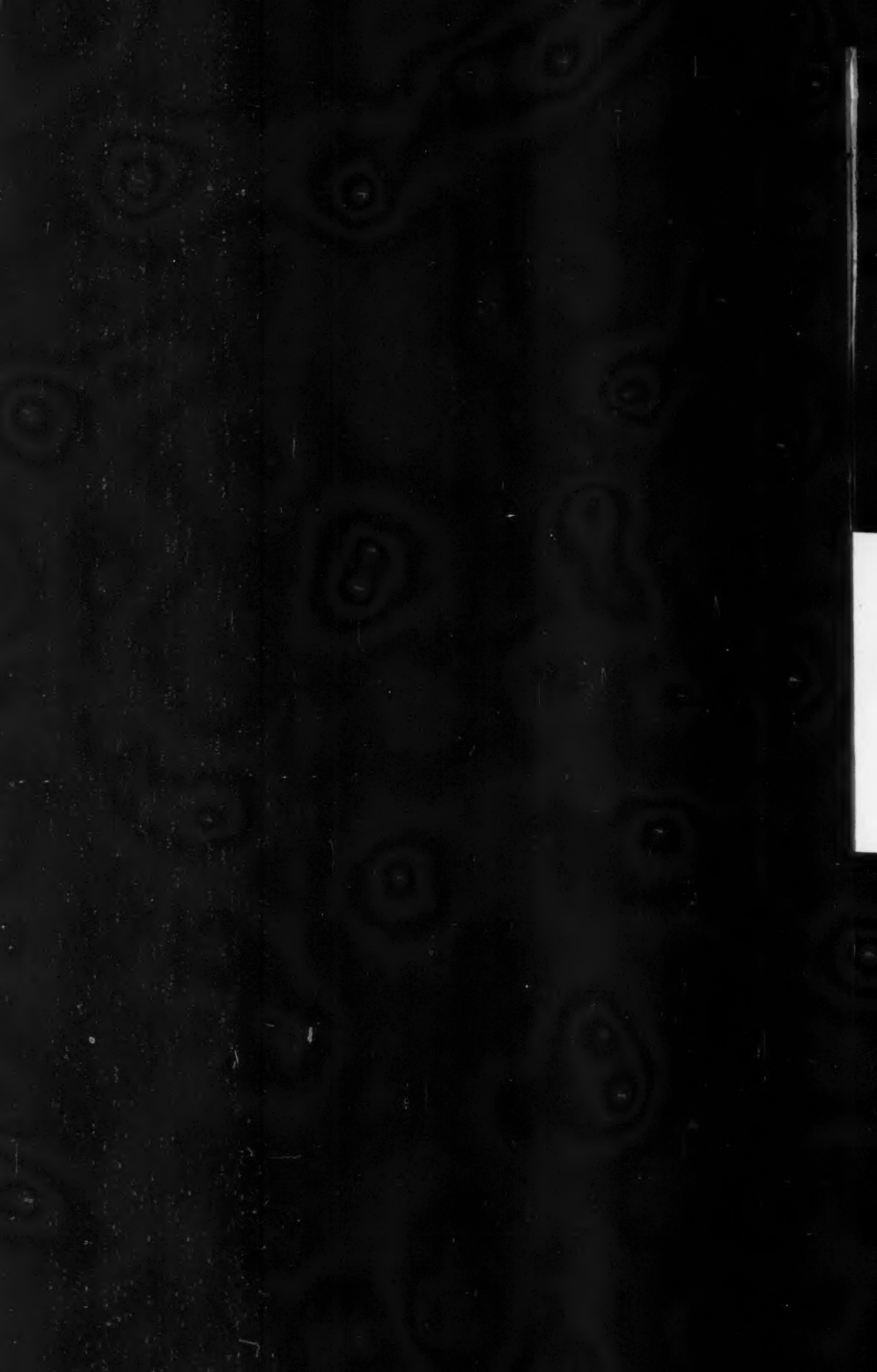
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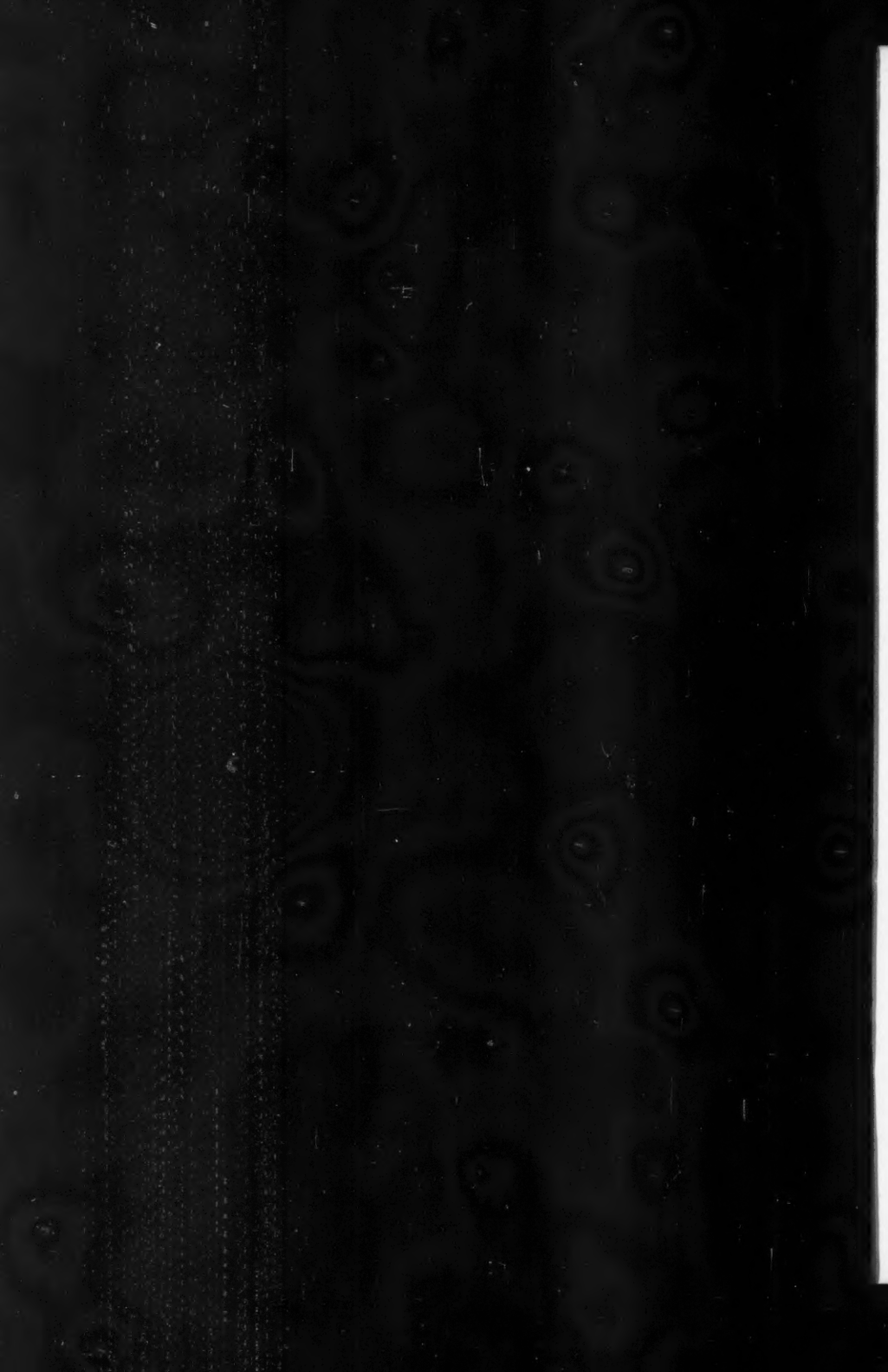
WHITEHALL YARD,
April, 1890.



ERRATA IN No. 151.

Page

- 46 *For* Die Botschaft höre, ich wohl, *read* Die Botschaft höre ich wohl.
201 „ Hindu Kop, *read* Koh.
202 „ Ingelfongen Hohenlohe, *read* Ingelfingen Hohenlohe.
203 „ Sergeant Marceau, *read* Sergent Marceau.
204 „ Almanach der Kriegs Hotten, *read* Almanach der Kriegs Flotten.



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Friday, January 17, 1890.

LIEUT.-GENERAL SIR WILLIAM D. JERVOIS, G.C.B., C.B., late
Governor and Commander-in-Chief, New Zealand, in the Chair.

THE LAND FORCES OF AUSTRALIA.¹

By Lieutenant-Colonel R. ELIAS.

THE time is steadily and surely approaching when the "defence forces" of the Colonies of Australia, each of which was at first just a kind of watch-dog at the door of its own particular colony, will have attained, in common with Australian institutions generally, to a state of development entitling them to throw off their provincial status and character, and become national, *i.e.*, when these forces will be consolidated into an Australian army under one commander.

It is no doubt right still to call them "defence forces," their chief duty being the defence of their colonies; but circumstances might arise which would cause them to combine with other troops of the Empire in operations neither strictly colonial nor exclusively defensive; as indeed we have already seen, when New South Wales sent a contingent to Egypt.

Everything is growing and expanding very fast in Australia, and the military forces are no exception. It would be a great mistake to try and hurry the growth; it will come of itself. Each defence force when first instituted consisted of only a few guns on the most vulnerable part of the coast near the capitals of colonies. Now, besides coast and garrison artillery, there are in each of the larger colonies—

Field artillery,
Engineers,
Infantry,
Mounted rifles,
Cavalry,
Cadet corps.

¹ The term Australia may sometimes include New Zealand. It is not easy to see yet to what extent New Zealand and other islands may be incorporated into any large defence system.

The infantry consists chiefly of militia, which may be called the "regulars" of Australia; there are also volunteers; and in addition there are rifle companies and rifle clubs (they are called by different names) in which men at any rate learn to shoot, although they have no regular military training; some of these, however, become consolidated into volunteer corps, and individual members of them frequently join the volunteers and militia. Of cavalry there is certainly not very much, but still a nucleus on which to form larger numbers if required. A certain portion of the artillery and engineers are "permanent," *i.e.*, what we should call "regulars" in this country.

Then there are in some of the colonies a naval brigade and naval artillery volunteers, who, as they sometimes parade and drill on shore, may be mentioned here. And the very excellent bodies of police, both foot and mounted, would make most valuable troops in case of need.

Belonging to all these branches there is arising a generation of local Officers, endowed with much natural ability and energy, who give a great deal of time to military duties, and take great interest in them.

Many Australian Officers have within the last two years been over here to spend some months in the study of military matters, at Aldershot, Shoeburyness, and wherever else anything of military interest was going forward. In the next two years we may expect a much larger number to come.

The general organization of all these forces is based upon that of the English Army; but there are differences, and differences which bear more or less directly upon that most important point in all armies—discipline.

In Australia, as we know, everything is democratic; there is therefore no such gulf recognized between the social standing of Officers and that of their men as in England and other old European countries; moreover, many men in Australia serving as private soldiers in the militia and volunteers are pecuniarily independent. It is needless to enlarge upon these two considerations; their importance is at once apparent; and it is also at once apparent that the old rules, regulations, and traditions with regard to the behaviour of Officers towards their men and the maintenance of discipline generally must be in some respects altered and modified to suit the altered and modified circumstances.

When a number of corps met in the capital of one of the large colonies a few months ago, for the purpose of carrying out some field manoeuvres in the neighbourhood, the Officer and men (all ranks) of one of them—mounted rifles, I think it was—entertained at a grand dinner the Officers and men of all the country corps then in the capital, to the number of about 100; the idea of giving the entertainment, said the newspaper where I read the account, having originated altogether in the ranks. This incident is interesting as an illustration of the pecuniary and social circumstances of Australian private soldiers.

A good many years ago Sir Frederick Weld,¹ speaking in Australia on the subject of discipline, expressed the opinion that the Anglo-Saxon race is naturally impatient of control, and the colonists perhaps even more so than the home members. Well, I dare say this opinion was perfectly correct at that time; but, I think that if Sir Frederick Weld were to see the different Australian defence forces now, he would modify that part of it about the colonists. At any rate, I have lately been informed by an ex-Commandant of one of the largest colonies, that he never found his men otherwise than most amenable to discipline.

The question of keeping order in a manner different from the old system (when we had long service in England) is by no means peculiar to colonial troops. Here is a paragraph on the subject which, it appears to me, it would be advantageous to quote, from the Prize Essay of the Royal United Service Institution, 1889:—

“The private soldier of to-day is a very different sort of man from the private soldier of even thirty years ago; his mental qualifications are of a far higher order, he is better educated, has more respect for himself, and is altogether of a more independent character, by which is meant that he is more capable of acting alone, and far more capable of understanding why under certain circumstances he is required to act in certain ways. Of course this development and progress has not been, and is not, altogether without its dangers. Where organic unity is required, individuality cannot be allowed to remain unchecked; consequently the problem of to-day is even a harder one than that of former years; for, recognizing an increased individuality, this quality has to be guided and controlled without being stifled.”

Directly I read the above paragraph it struck me that, although not specially intended to apply to colonial corps, it did nevertheless apply to them very significantly; for the members of them certainly possess much intelligence, education, and individuality; and it is worthy of remark that owing to short service and the changes and modifications which have followed in its train, European armies do not differ so much in general character and organization from a highly trained militia as the old long service armies did; and, again, owing to the gradual growth and development of late years of a large portion of the Australian forces from a simple volunteer movement into a well organized militia as the backbone of the inland forces, there is a most decided, and still growing convergence in the organization of European and Australian troops; they are from different starting points gradually assuming a more uniform character. This in itself is no small matter for congratulation; for as long as there remains any chance of troops from different parts of the world having to act together the advantages of uniformity in organization, arms, ammunition, equipment, and training can scarcely be overrated. Unity and uniformity should be the great aim of all the Australian forces.

¹ Premier of New Zealand in 1864; afterwards Governor of Western Australia; and, later, of Tasmania.

We hear much of "esprit de corps," and up to a certain point it is beneficial; but it contains a great danger; if the idea is not struck broadly and boldly we get on the wrong side of that line which divides "esprit de corps" from petty jealousy of one's neighbour corps. I have seen two private soldiers engage in personal combat simply because one had white facings and the other yellow. I know there are some who maintain that such an occurrence shows an excellent spirit. I confess I am not of that opinion. The "esprit" should be on a large scale—in the present case, the honour of the Australian army—perhaps the Imperial army. To pull together as members of one National or one Imperial force is a higher aim, and more conducive to concord and to success than anything to be expected from the promotion of a species of emulation nearly akin to jealousy between the parts.

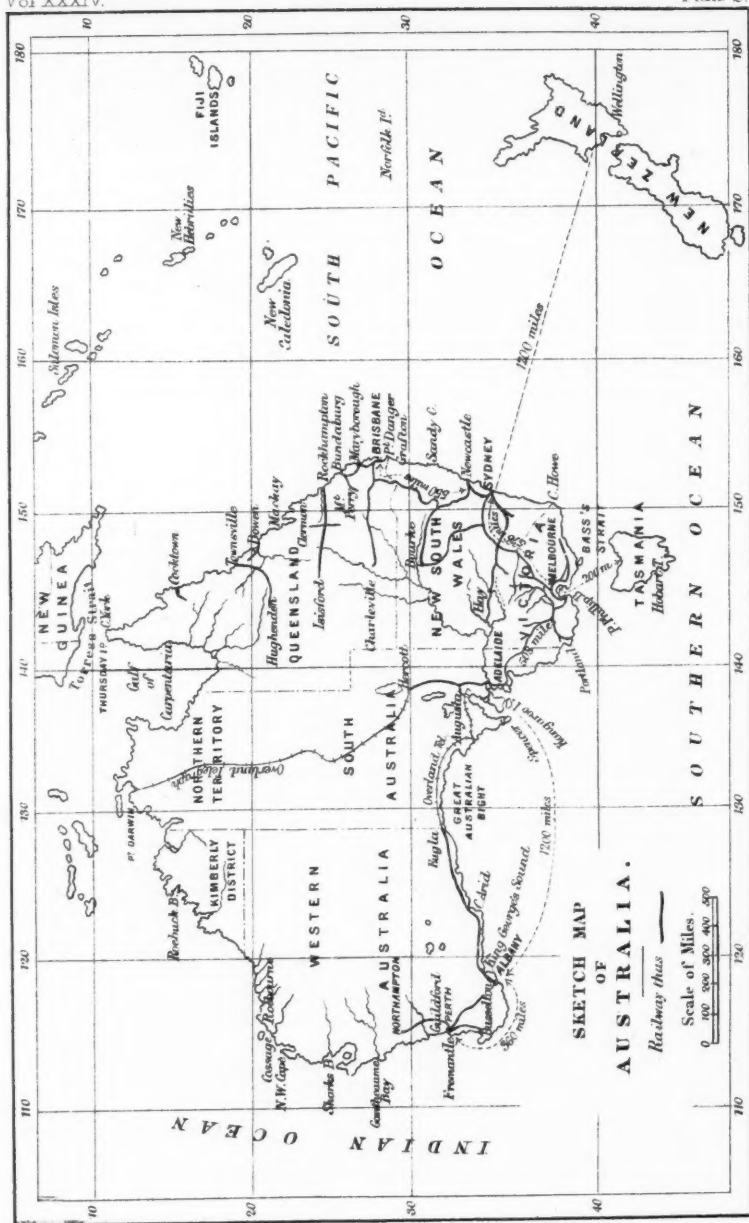
The best way to counteract any narrowing tendency, should such exist, would be to bring together the forces of different districts, and, if possible, of different colonies, in numbers as strong as possible for manœuvres and encampment. As it is, the forces of each of the larger colonies of Australia turn out annually for at least a week's continuous training; but as yet only each force in its own colony. It would be most advantageous to all if the forces of different colonies could meet and be brigaded together. But how is this to be effected? At present there is no code under which an Australian body of troops could in time of peace be governed outside its own colony; but, assuming that this is an obstacle which legislation in the not very remote future will remove, there still remains the fact that distances in Australia are very great. It might not be impossible, however, to bring the troops, for instance, of New South Wales, Victoria, and South Australia into camp together at some convenient spot in Victoria. Several combinations of this kind might be made, the colonies taken three and three together, as the mathematicians say. Tasmania might easily be included; but New Zealand, I fear, would be too far off. The journeys by rail or sea, embarkations and disembarkations (train or ship), would all be capital practice, and most useful military experience. This is merely a suggestion of what perhaps might be done even before the amalgamation of the present defence forces into an Australian federated force.

With regard to the distances, it may be advisable to give a few of them approximately:—

	About
From Perth to Albany, by sea	360 miles.
„ Albany to Adelaide, by sea	1,200 „
„ Adelaide to Melbourne, by rail..	508 „
„ Melbourne to Sydney, by rail ..	576 „
„ Sydney to Brisbane, by rail	550 „
„ Melbourne to Tasmania, by sea.	200 „
„ Australia to New Zealand, by sea	1,200 „

The general interest taken by Australians in military affairs has within the last year or two increased enormously. If we look back only a few years at Australian journals, records, books of various





descriptions, and lectures delivered, some in England and some in Australia, we shall find there very little, and usually nothing at all, about any naval or military matters whatever. But now it is very different. Many of the daily papers—the “South Australian Register” for example—have every now and then capital articles on military matters and defence, to say nothing of accounts of parades, field days, reviews, &c., and letters and paragraphs of varying degrees of knowledge of the subject, ability, pugnacity, and patriotism—but all admitting the absolute necessity for being in a position to offer a sturdy self-defence in case of need. And all are now becoming convinced of the fact that, in order to have a really effective militia, some strenuous training, including a period of several days in each year of continuous training, with troops living and messing together, is quite indispensable.

Occasionally only we find expressed what I may perhaps call the old style of opinion, like the following (from a colonial newspaper):—

“Too little account is made by purely military critics of our unprofessional soldiery, and of the motive springs by which a nation, when a great need impels, will rise to the occasion,” &c., &c., and the American War is quoted as a brilliant illustration of “eager volunteers after a very brief period of drill, but inspired by a cause, being able to fight battles which, for the skill and valour displayed, have never been surpassed in ancient or modern times.” Well, as we all know, a study of the events of the American War by no means bears out this writer’s ideas, but, on the contrary, exposes the great drawbacks and losses experienced by want of training; and the Australians of to-day are perfectly well aware of this, and are not in the least likely to be misled by such a flimsy, frothy paragraph; they know that if the troops of any European Power should land in any part of Australia, these would certainly not be unprofessional soldiers; and that the Australians destined to meet such an attack would have the great advantage of being on their own ground, with which they are familiar; but that to act in concert, and to turn that knowledge of the ground and locality to account, is impossible without training and practice.

Many of the inhabitants of South Australia are so impressed by the advisability of providing a fairly trained and disciplined force with a reserve, that a serious movement was made a few months ago to bring in a law for a measure of compulsory service by which every able-bodied young South Australian should pass through the ranks of the militia. There were several meetings and lectures on the subject. At a meeting of the Adelaide Literary Society the question was debated, “Should military service be compulsory in the Australian colonies?” There was a large attendance, and the affirmatives carried their point by a large majority. “The volunteer system,” says a leading article in the “South Australian Register” (8th July, 1889). “has been tried in almost every conceivable way, and proved hopelessly wanting.” The militia, some eight or nine hundred strong, are not enough, it goes on to say; and then strongly advocates compulsory service for three years or less, if possible, for all classes of

the community—and also dwells on the necessity of pay, if real efficiency is to be expected. In the South Australian Parliament the question of compulsory service was debated on, and naturally enough not without opposition; no action was taken, the Ministry being unfavourable to the movement, which therefore at present remains in abeyance.

What has been proposed is, I believe, to enlarge the scope of and put in motion the "compulsory" clauses already existing in law—but, as yet, for application in time of war only; so that 1,000 men might be taken by ballot between the ages of twenty and twenty-one in Adelaide and its suburbs, and passed after three years' service into the reserve; by which, allowing for contingencies, it is expected that besides the 3,000 men in the active militia, a reliable reserve of at least 5,000 men at the end of ten years would be formed without unduly pressing upon any one class. This is from what I can gather the outline of the scheme. Independently of compulsory service, however, an additional militia battalion has just been raised in South Australia.

Nobody wants for a moment to eliminate the volunteer forces, but it is universally felt that volunteers alone do not make an Army; and it is very clearly seen that if men do not come forward of their own accord for military service, there are only two ways of inducing them to do so, viz.: by law (ballot, as being the mildest form of compulsion), or by the offer of substantial pay; both of these being measures calculated to make Ministries hesitate.

When the Australian defence forces were in course of formation a good many useful hints were found in the regulations and constitution of the Canadian Militia; but in Australia the compulsory part has not yet been adopted. There is always going on among all the principal colonies of the Empire a regular annual exchange of blue books, militia lists, and new regulations concerning the respective Defence Departments, which is found to be very advantageous.

I will here give as briefly as possible the chief provisions of the Canada Militia Act (1886): "The militia shall consist of all the male inhabitants of Canada of the age of eighteen years and upwards, and under sixty, not exempted and disqualified by law, and being British subjects by birth or naturalization; but Her Majesty may require all the male inhabitants of Canada capable of bearing arms to serve in case of a *levée en masse*." There are four classes, according to age, and whether married or single, &c.; there is active and reserve militia, land force; and active and reserve militia, marine force; and a fairly long table of exemptions, as is usual in these cases. Although compulsion or conscription is legal, it is not found necessary to resort to it; resembling herein the case of the English Militia.

The Swiss Army also, which I have heard described as "not a piece of military perfection, but the most superb militia ever seen," well deserves consideration with reference to organizing an Australian Militia. In it every male citizen (after certain exemptions), between twenty-four and forty-four years of age, is bound to military service and drill. The men of the infantry are all capital shots; and even

the boys at school win prizes for shooting—like the cadets in Australia. Switzerland may be said to have led the way in the introduction in Europe of that universal liability to military service, which many years later has come to be general all over the continent.

In the present state of the Australian forces, when it is everywhere admitted that the want of unity and cohesion between the troops of the different colonies is a real inconvenience, and a drawback to efficiency on any large scale, calling for an early remedy, it will be interesting to note that the Swiss had a similar difficulty to contend with, before the troops of the several cantons were consolidated into one federal force. This was chiefly the result of a reorganization carried out in 1874. Each separate canton is now responsible for the recruiting and maintenance of a certain military force proportionate to its area and population; it bears the cost of this force, and to a great extent the patronage and control of the same is vested in the cantonal authorities under the superintendence of the War Department at Berne; but the right of disposing of the whole Army, as well as the war "matériel" attached to it, belong to the Confederation. Some further particulars on this and other points of interest will be found in the compilation noted at foot.¹

Should any one wish to see how far the motto "Advance Australia" has already been applied to military matters he can easily do so, as far as regards numbers, by comparing the tables of the different forces at the present time, taken from the latest available statements, with the table of numbers given by Sir Peter Scratchley about seven years ago. These tables will be found at the end.

The mere numbers, however, give but a feeble idea of the progress made. Besides increasing the number of men, additional guns of the most modern patterns—some of large calibre for coast protection—are constantly being received from England; torpedoes and submarine mining have not been neglected. And here I may mention that General Edwards, during his late tour of inspection in Australia, wisely warned all concerned against putting too much faith in complicated machinery which might perhaps get out of order or become disabled—strength and simplicity of organism and mechanism being the very foundation of all things military.

In Melbourne a school of instruction for Officers has been founded. Other colonies would doubtless also have their own; but it is hoped that before long there will be one Australian military school or college. In New South Wales an United Service Institution has been established, and one in Melbourne, if not already opened, will be established immediately; premises for its accommodation were secured some time ago. There is also in Melbourne a rifle ammunition manufactory, the first step towards Australian factories for arms and warlike stores of all descriptions. Up till now ammunition and stores have, chiefly on economical grounds, been imported from England, which is all very well as long as there is free communication between

¹ "The Armed Strength of Switzerland," compiled in the Intelligence Branch of the Q.M.G. Department. By Major Russell, 14th Hussars. 1880.

England and Australia; but it is now admitted on all hands that in case of emergency Australia must be self-dependent.

"Good must result," said Sir Peter Scratchley, "from periodical consultations between the various military commandants of colonies;" and these Officers do constantly correspond and exchange ideas on various subjects. All of them being, or having been, "Imperial" Officers, they are entirely free from any provincial ideas about their own particular colony, serving that particular colony none the less with the utmost interest and devotion. And this is a great point, not only for themselves, but also because it is in their power to raise and enlarge the views of those under their command.

The payment of troops in the different Australian colonies in case of any question arising of soldiers from different colonies being called out to act together, might create some little difficulty. Their rates of pay differ considerably. In South Australia a militia Captain receives 12*l.* to 14*l.* per annum, while in Victoria his pay is 36*l.*, with extra allowances when in camp. A mounted Officer in South Australia receives about 5*l.* forage allowance, but in Victoria about 50*l.*, and there is as great a proportionate difference in the pay of non-commissioned Officers and men. If it should be considered necessary for troops brigaded together to be paid at a uniform rate, an agreement as to the amounts in each case will no doubt be arrived at by the representatives of different colonies.

No one can consider the more recent additions to the Australian forces without noticing especially the mounted infantry and the cadets.

These two institutions, though not peculiar to, are nevertheless particularly characteristic of, the country. For a nation of horsemen, what more natural arm than mounted infantry? Cavalry, one might perhaps say. Yes, but large numbers of regular cavalry are not called for—at any rate at present—on a continent complete in itself, like Australia or Tasmania, or the islands forming New Zealand; unlike Canada, abutting on the United States. It is very unlikely that any large body of European cavalry would be landed for an attack on Australia. There would be not only the difficulty of bringing them there, but also of maintaining them when landed; occasional scarcity of water, of which I shall have something to say presently, being one obstacle which would have to be surmounted.

If from any combination of circumstances at present unforeseen, the small amount of cavalry in Australia should require reinforcement, the native cavalry of India is tolerably near, highly efficient, and singularly suitable, as regards climate, for instance.

To well trained mounted infantry on their own ground, knowing the country, nothing should be impossible. No doubt they ought to be frequently exercised in considerable bodies; this, however, is not so easy, as they are very much scattered,—long distances often separating the dwelling places of different members of the force, with of course their horses,—for each man finds his own mount.

Although, as is always very properly insisted upon, mounted infantry must by no means be looked upon as cavalry—no charging,

or fighting on horseback—still, when cavalry is scarce, many of the duties properly belonging to it would have to be performed by mounted infantry. There is surely no reason why mounted infantry should not act efficiently as scouts and vedettes, and carry out reconnaissance duty in all its branches. Did not some of the German cavalry in 1870-71 arm themselves with the Chassepôts of French prisoners, for the purpose of using them when reconnoitring, becoming thereby something very much like mounted infantry? Victoria possesses a fine body of this arm; but up to the present they have been volunteers, receiving only a capitation grant. It is intended, I am informed, to bring them under the head of militia, which will doubtless be much in favour of their training and efficiency.

As to the cadets, it is almost superfluous to remark upon the plain and conspicuous testimony they bear to Australian military spirit, and what a substantial voucher they are for its continuance and extension. The Minister of Public Instruction for Victoria reported lately¹ that military drill was taught in 215 schools by 261 qualified teachers. The average attendance at the classes was 13,202 cadets, showing an increase on the previous year of 3 schools, 20 qualified teachers, and 652 scholars. There has also been an important change with regard to instruction, which has hitherto been conducted entirely by members of the educational staff, but is now in the hands of the Defence Department. Classes for instructing school teachers are established in the principal towns of Victoria, under non-commissioned Officers, and are attended regularly by more than 150 teachers. There is scarcely any large school now in which a company or detachment of cadets does not exist, learning drill and the use of firearms, combined, of course, with lessons of order, self-restraint, and prompt obedience.

Last October there was an encampment at Langwarrin for cadets alone, who turned out, to the number of about 2,000, for four days' continuous training. In New South Wales also, and other colonies, the cadet corps are meeting with much attention and encouragement.

One often hears about scarcity of water, and droughts in Australia. It may be that this very serious drawback affects the interior of the continent more than places near the coast, where a possible landing might be made, and in the neighbourhood of which campaigning might be carried on; but even here, near the coast, considerable difficulties in getting water in any respectable quantity are often encountered. This condition has always been looked upon in Australia as decidedly in favour of the defence, and against the attacking side (i.e., considering an attack by a foreign Power from without). Even at the annual and other encampments elaborate arrangements are necessary for the provision and storage of water. "Water holes" are dug to catch and hold the rain water. In some instances water is carried in casks, &c., for some distance, from the nearest wells. To a camp at Queenscliff (Victoria) water had to be transported by

¹ "Argus" (Melbourne), 5th October, 1889.

water trains, that is, tanks were placed on trucks and run down by rail.

It has long been known that there is a very large supply of water underground in various parts of the continent. It has long been thought that there is an inexhaustible supply, not yet discovered, in many other parts of the continent; and the Government Astronomer of New South Wales is said to have expressed his opinion that there are "several Murrays running underground," which we need only bore for in order to unearth, and place them at our service.

Another important consideration is the railway system. As to the rapidity with which the lines are being increased and extended, there is nothing to complain of, but it is only too plain that they have not been constructed with a view to military operations. It would be rather surprising, under the circumstances, if they had. Taking the long stretch of continuous railway from Adelaide through Melbourne and Sydney up to Brisbane, we find no less than three different gauges: from Adelaide to Melbourne the gauge is 5 feet 3 inches; in New South Wales it is 4 feet 8½ inches; and in Queensland it is 3 feet 6 inches.

Whether an extra rail could be laid inside or outside those already existing, as on the Great Western Railway, in England, I know not. Such a measure has been proposed, so that there may be an uniform gauge of (say) 4 feet 8½ inches throughout, or whether any of the numerous "safe and rapid transfer systems" offered by ingenious inventors for substituting other axles, or contracting and expanding the same axles on reaching a break of gauge, will be adopted, remains to be seen. But I will venture to prophesy that "advancing Australia" will before very long find some means of removing the inconvenience.

Long ago Sir Peter Scratchley directed attention to the utility of pack animals for transport in case of inland campaigning, the more so, as the employment of pack horses would be nothing new to Australians. But for military transport it might be better if a sufficient number of mules could be bred for this purpose. They might, perhaps, be utilized in time of peace for purposes other than military. They are hardier, cheaper, more easily subsisted,¹ and generally more suitable than horses for military transport. In Afghanistan they did capital service when employed during the latter part of the campaign in 1880, when they were to a great extent substituted for camels.

In most of the settled parts of Australia, however, the country is fairly level, so that wheel transport should be the rule, and pack animals the exception. Mountainous country, where wheels cannot go and pack animals are absolutely necessary, is not common in Australia.

In New Zealand, when the Maori war was going on, bullock carts were often used; light handy drays, capable of conveying half a ton, drawn by four or even two bullocks. They were rather slow, but

¹ Horses, however, are easily subsisted in Australia; and a horse in the bush generally "cuts his own bread and butter."

the only kind of transport to be relied on in winter, in some parts of New Zealand, where deep ravines and rivers had to be crossed, and journeys made over unmetalled roads, cut up by traffic and heavy rain. Pack horses also were used by the commissariat.

New Zealand is far enough off from the Australian continent to be open to a separate attack, should there be any inducement to make one. Owing to the position which New Zealand occupies as an advanced shield to the principal parts of Australia, an enemy coming from the eastward might perhaps first direct an attack upon her, all the more so as defences and military matters generally are in no such state of efficiency as they are in Australia. On the other hand, when richer Australia is within reach, offering a more tempting prize, New Zealand might be left in peace.

The New Zealand military forces are regulated by the "Defence Act, 1886." All male inhabitants between the ages of 17 and 55, including natives, are liable to serve in the militia; but there is a long list of exemptions. There are three classes:—

- (1.) Unmarried men, between 17 and 30.
- (2.) Married men, between 17 and 30, and unmarried men between 30 and 40.
- (3.) Married men between 30 and 40, and unmarried men, between 40 and 45.

The Governor shall (says the Act) cause the whole of the militia, or such part thereof as he may think proper, to be trained as a military force. No militia is compelled to attend for training and exercise for more than 168 hours (one week) in one year.

The Governor may cause a sufficient number of fit and able men, whether Europeans or Natives, to be embodied from time to time to serve as a permanent militia force in and throughout the country, or beyond the limits thereof, for resisting the common enemy, putting down rebellion, quelling disturbances, and preserving the peace. But the permanent militia in New Zealand was lately considerably reduced, and are principally stationed at the fortifications of the large ports. The volunteers consist of a number of small corps, an arrangement not conducive to efficiency. There is a fine body of armed constabulary numbering upwards of 800 men.

There are several points in which New Zealand differs from Australia. The inhabitants are scattered all over the country instead of being, as in Australia, chiefly near the coast. There are many more probable points of attack. The coast of New Zealand abounds with harbours all round, and as they and the whole coast line cannot all be made impregnable, a mobile inland force in case of attack is all the more necessary. When fighting was going on in New Zealand in 1864-65, the colonial volunteers often did very good service; and it was said by many that they were more suitable for fighting in the bush than the men of the British regiments. At that time the local militia could be employed only within a certain radius from their own province or settlement; that disability has now been removed. Whether New Zealand shall be included in any future Australasian federation scheme or not, it is important that uniformity in armament,

ammunition, and organization should prevail throughout the forces of Australia and New Zealand.

When we speak of unity and uniformity in Australian military matters it naturally occurs to us what a large territory West Australia is, and what a small force they have there as yet; only a few volunteers; no militia, no permanent force, and very little in the way of military works. But now that this important territory is about to put off its youthful character of Crown colony, and to assume the dignity of a self-governing community like its neighbours, or perhaps, to become like them a member of an Australian Dominion, it is certain that the defence arrangements will in due time be increased, and be modelled on a plan conformable to that Australian unity which is so desirable and necessary.

And now just a word or two on the nature of a possible attack on Australia.

As long as the world jogs along pretty quietly, there appears to be no special danger of any attack at all; particularly if it is everywhere known that these colonies are well armed and protected by sea and land. But whenever there has been any sign or probability of war between England and any great Power, immediately we have seen a "war scare" spring up in Australia; and no doubt we shall see it again. As to the form an attack might take, there have been many conjectures. A squadron composed of a few ships—some perhaps ironclads—capable of landing 2,000 men, or more, might be sent. It "might issue from the Russian port of Vladivostock or Petropaulowski, from the French port of Saigon, from San Francisco, or from some other quarter. Eluding our cruisers, and appearing suddenly before Sydney, Melbourne, Adelaide, or in Moreton Bay, it might capture the merchant vessels lying in the harbours, intercept any of the numerous vessels conveying valuable shipments of gold, or, under threat of bombardment, or after actually firing into one of the large towns, demand and obtain a payment of many millions of money."

It has been also suggested that armed merchant vessels possessing great speed and coal vitality might in time of war do great damage both to shipping and exposed ports, and could more easily evade our cruisers.

If it should be attempted to land troops for an attack, some place for the landing where there were no fortifications would be chosen. This fact should be considered by those who depreciate the necessity of inland forces for Australia. Should such a landing be effected, nothing but infantry, cavalry, and field artillery could stop the invaders from marching upon and entering any large town.

No one ever seems to think of an attack on Australia by the United States. Nevertheless, under certain circumstances such an event might occur. Maré Island (San Francisco), the United States naval arsenal and dockyard in that part, is only 6,460 miles from Sydney, or something like half the distance between Portsmouth and Sydney; Vladivostock, the Russian base, is about 5,000 miles from Sydney.

¹ Sir William Jervois. Address to New Zealand Institute, October, 1884.

and was founded in 1860, with the intention of making it the chief naval station on the Pacific seaboard; considerable sums have been spent on its docks, piers, arsenals, and fortifications.

Captain J. C. R. Colomb¹ remarks: "The Russians moved without steam power military forces, stores, and guns backwards and forwards in 1854 over a sea line nearly 900 miles long in the North Pacific, in complete defiance of the combined naval forces of France and England. It is not wise to rely entirely on the power of fleets to prevent the despatch of expeditionary forces from either Vladivostock or Maré Island. There is no physical impossibility to prevent either Power working from these bases from transporting a complete corps of 5,000 men without any great effort to the shores of Australia. In war the only matter to be considered by them is the reasonable prospect of success. This prospect of success can only be estimated by our preparations for defence. In inverse proportion to our preparations for resistance will be the arguments in favour of attack."

I will only mention one more point from which it appears that an attack on Australia has by some been considered possible. That point is France, and the period, the reign of Napoleon III. Here is a paragraph on the subject from the *Life of Lord John Russell*,² published only lately: "There is still among Lord John's papers a singular document which purports to be a translation of a series of confidential questions issued by Napoleon III on the possibility of a French expedition, secretly collected in different ports, invading, conquering, and holding Australia. How the paper reached the Foreign Office, what credit was attached to it, what measures were suggested by it, there is no evidence to show." Although the integrity of this paper, and the existence of the project it treats of, are far from being proved, still no one can say decidedly that no such project existed.

There are some minor matters in the present constitution of the Australian forces on which I intended to remark; but I will pass them over, because it is evident that the present is a mere state of transition. The decided movement in favour of colonial federation, coupled with the late inspection of the defences and defenders by Major-General Edwards, leaves no room to doubt that the federation or amalgamation of the military forces into one Australian army must before long be carried out.

On this amalgamation one important measure entirely depends, viz., the strengthening and garrisoning of Thursday Island, King George Sound, Hobart, Port Darwin, and perhaps some other strategic points.

With a view to the provision of these garrisons, among other reasons, a moderate force of permanent infantry will probably be required. A body of permanent mounted infantry has lately been established in New South Wales, with horses provided by Government; instead, however, of being armed with infantry rifles, they are

¹ "Defence of Great and Greater Britain."

² By Spencer Walpole.

armed with carbines. If found advisable, the armament might of course be changed.

It is worthy of remark that in Australia considerable difficulty has been found in getting reserve men together when wanted. This partly comes from the colonies being so large in area, and large numbers of the men being frequently on the move from one district, or from one colony, to another. In Victoria therefore the volunteers, and especially the Rangers, have come to be looked upon as more or less supplying the place of reserves.

General Edwards has offered some suggestions, and proposed some lines on which to form the amalgamated Australian forces. I will endeavour to summarize his chief propositions:—

1. Federation of the forces.
2. Officer of rank of Lieutenant-General to be appointed, to inspect in peace time, and to command in war.
3. An uniform system of organization and armament, and a common Defence Act.
4. Amalgamation of "permanent" forces into a "fortress corps."
5. Federal military college for the education of Officers.
6. The extension of rifle clubs.
7. Uniform gauge for railways.
8. Federal small-arm manufactory, gun-wharf, and ordnance store.
9. An Australian uniform, Khaki colour, something like Victorian Mounted Rifles.

Also that a considerable number of cadres, especially of infantry militia, should be formed, so as to have great and speedy powers of expansion in case of necessity.

He considers the most suitable unit to be a brigade of all arms, to consist, at present, of about the following strength on peace establishment:—

	Men.
Infantry, 2 regiments of 2 four-company battalions, each battalion 300 strong	1,200
'Mounted rifles, 1 regiment of 6 companies	360
Field artillery, 2 batteries, each 6 guns	180
Engineers, 1 field company.....	60
Commissariat, medical staff, &c.....	110
Total.....	1,910

When mobilized, such a brigade could quickly be expanded to 3,000 men; later, perhaps to 5,000.

Queensland and South Australia can supply a brigade each; New South Wales and Victoria, two brigades each, and later, it is hoped, three each.

These brigades would be readily adaptable to combined action. The Queensland brigade with the northern brigade of New South

¹ Of course for the present mounted infantry must in a certain sense supply the place of cavalry.

Wales, under the Queensland commandant, would form a division for the defence of the coast from Brisbane (N. terminus of the railway) southwards. A second division would be the two remaining brigades of New South Wales, under the New South Wales commandant, to cover Newcastle and Sydney. A third division for Melbourne would consist of two Victorian brigades, under the Victorian commandant; and a fourth division made up of the remaining brigade of Victoria and the South Australian brigade, under the South Australian commandant, would cover Adelaide.

Assembled, they would be an army of 30,000 or 40,000 men, and should be able to defend any point from Spencer's Gulf to Moreton Bay, or even Rockhampton, when the railway is completed.

The proposed fortress corps would consist of the amalgamated permanent forces of garrison artillery and submarine miners of different colonies, viz. :—

	About		
Queensland	104	artillery and submarine miners.	
New South Wales ...	464	"	"
Victoria.....	287	"	"
South Australia.....	48	"	"
Tasmania	24	"	"
	<hr/>		
	927	men.	

With some slight increase of its numbers the fortress corps would be utilized to garrison proposed defences at King George Sound, Thursday Island, and other important points. It will certainly be found that a proportion of infantry is necessary to its efficiency.

The interests of the whole continent demand, as General Edwards remarks, that railways to connect Port Darwin and West Australia with the other colonies be made as soon as possible. By and by other places will require consideration from a defensive point of view: New Guinea and Fiji, for example.

Now, having attempted to give an idea of the growth and present condition of these forces, together with an outline of the plans of the Australians for the formation of a national army, I think I am only expressing the sentiments of all present in saying that we very sincerely wish them success.

THE LAND FORCES OF AUSTRALIA.

Extract from Table of Strength and Composition of Australian Military Forces (from Papers of Sir Peter Scratchley) about 1882.

Colony.	Paid forces (total Officers and men).				Unpaid Volunteer Force (total Officers and men).						Grand total, paid and unpaid.
	Permanent artillery.	Volunteer Militia.			Cavalry.	Artillery.	Engineers.	Torpedo.	Infantry.		
		Artillery.	Engineers.	Torpedo.						Infantry.	
New South Wales.....	319	300	60	100	1,340	—	—	—	—	2,119	
Victoria	125	—	—	—	—	125	1,016	18	2,191	3,725	
South Australia.....	50	150	—	—	780	—	—	—	900	1,880	
Queensland.....	—	—	—	—	—	—	250	60	755	1,065	
Total	494	450	60	100	2,120	125	1,266	328	3,846	8,789	

EXTRACT FROM LATEST AVAILABLE SOURCES (IN ENGLAND), 1889.

New South Wales.

Regular artillery.....	370 all ranks.
Volunteer artillery.....	560 "
Engineer corps	101 "
Torpedo corps.....	160 "
Four infantry regiments.....	2,056 "
Reserve { 10 troops cavalry	3,240 "
{ 4 batteries artillery	
{ 40 companies infantry.....	
Total.....	6,487 "

Victoria.

Staff, &c.....	40 all ranks.
Permanent artillery.....	224 "
Other artillery	940 "
Cavalry	61 "
Engineers	182 "
Mounted rifles.....	1,017 "
Infantry (militia and rangers).....	2,099 "
Medical staff, ambulance, &c.....	80 "
Reserves	1,000 "
Total.....	5,643 "

South Australia.

Staff, &c.....	12 all ranks.
Permanent artillery.....	45 "
Field artillery.....	80 "
Garrison artillery	77 "
Cavalry	60 "
Militia infantry, 3 battalions	900 "
Volunteer infantry.....	1,130 "
Volunteer mounted infantry.....	550 "
Re-engaged.....	130 "
Total.....	2,984 "

Queensland.

Permanent force, and corps paid while on duty only.	{ 8 batteries artillery ...	} about 2,270 all ranks.
	{ 1 company engineers...	
	{ 3 regiments infantry...	
	{ 5 companies rifles.....	
	{ 5 companies mounted in- fantry.....	
	Volunteers	" 1,030 "
	Total	" 3,300

This gives a total of 18,414 of all ranks for these four colonies, which about 7 years ago only mustered 8,789. The numbers are only approximations, and are exclusive of rifle clubs, marine corps, cadets, and police.

P.S.—I am informed on reliable authority that in the above table of strength at the present time the forces of Victoria are considerably understated. This remark probably applies also to the other colonies therein mentioned. The discrepancy arises from the "Year Books," &c., of 1889 (compiled at the end of 1888) being the latest at hand in England. A liberal margin must therefore be allowed for increase in strength since then.—R. E.

Lieutenant-Colonel G. T. CARRÉ, R.A.: Whilst touring through the Colonies during the summer months of last year, I interested myself in obtaining information as to their powers of self-defence; and with this object inspected, unofficially, the defences of Australia, Tasmania, New Zealand, and Canada. On my arrival in England, I embodied the result of my research in a report, which has been accepted by the Intelligence Department at the War Office. I trust that my experiences may permit me to make a few remarks on the interesting lecture we have just heard read. I was throughout my travels much struck with the noble way in which each Colony has responded to England's call in defending their coast line and important towns from invasion. Victoria especially is in possession of a system of defence-works at Queenscliff, Crownest, Western Fort, and Swan Island, which, armed as they are by powerful guns of the latest manufacture, would in my opinion defy the most powerful armour-clad ships attempting to run through the double line of fire defending the entrance to Port Philip Harbour. The lecturer has informed us that with the exception of Western Australia, each Colony possesses a force of its own, consisting of a small number of permanent troops supplemented by a partially paid army and volunteer corps; and I judge from the tendency of his lecture that the object of his discourse is the consideration of combining these small armies under one organization for the defence of Confederated Australia and the Empire of which they form so important a portion. I discussed this question locally on several occasions, and left the Colonies with the idea that such an organization could only take place when Australia came under a supreme Government and had a greater assimilated interest in trade than at present. Tasmania and New Zealand possess neither the mineral wealth, commercial prosperity, nor population of Australia, neither does their financial status justify them in following the example of heavy expenditure (Victoria spent last year, in defence works and army, 300,000*l.*), or maintaining an army of partially-paid troops sufficiently large to defend their extended coast line. New Zealand depends on local defences. Dunedin, Christchurch, Wellington, and Auckland have each their local defences, and, except by sea, have no direct communication. They thus stand, as it were, isolated. Auckland is strongly fortified, and I should like to quote it as an example. The beautiful harbour is defended on the north shore by a powerful battery of 9-inch and 6-inch B.L. guns, supplemented by a cross fire from the south shore by a battery of two 6-inch B.L. h.-p. guns. Similar batteries, situated further up the harbour, form a second line of cross fire, which is supported by a battery of smooth-bored guns massed on a hill which commands the whole. This system of defence is very powerful, but to perfect its protection Auckland requires organization. Though, as we have just been told, New Zealand possesses a Defence Act by which the whole population can be called out to defend the islands, yet I saw that in reality they have scarcely any men to properly man the guns or protect the defence works. Whilst speaking to the volunteers on the subject, they appeared to quite realize the fact; but at the same time they informed me that the owners of property and shopkeepers were quite prepared to educate themselves to become efficient gunners and infantry in sufficient numbers to man the guns with twenty men for each piece of ordnance, supported by an infantry corps of 2,000 men. Such an organization would, in my opinion, secure the defence of Auckland, and all the New Zealand ports.

Sir FREDERICK YOUNG, K.C.M.G. (Royal Colonial Institute) : I have listened—as I have no doubt everyone present has—with great interest to the very important paper that has been read to us by the gallant Colonel. It would be, of course, impertinent in me, as a civilian, to indulge in any minute criticism as to the different modes in which a military man suggests that certain military matters should be undertaken ; but this inference I draw from listening to Colonel Elias's paper, namely, that co-operation in military matters is as necessary as it is in all other matters, in order to ensure success. I was very much struck, therefore, with the general character of the tone running through the paper, and the contention that all the different parts of Australia would be much more efficiently defended, and the defence would be much more economically carried out, if all the great Colonies would unite under one head for the purpose of carrying out their military organization, and for the security of their great island continent. A remark was made by the gallant Officer who preceded me, to the effect that he did not think that anything of the kind could be carried out until Australia formed itself into what he was pleased to call a Nation. Now, the only difference I have with the gallant Colonel is this, that I would take exception to the word "Nation," as far as Australia is concerned. If it be regarded as a part of the great British Nation, then I entirely agree with him ; but I should not like it to go forth that I, who have been for many years such a strong advocate of what is called, for want of a better name, Imperial Federation, should concur in the opinion that it was desirable that Australia, in the great movement which is now commencing, and which I think, before many years, will probably be carried out, should put herself into the position of becoming a separate Nation. If she is to continue an integral part of the great British nation—that is what I should wish, and I think what we all desire. The lecturer alluded to one or two points with which I was much impressed. He spoke of the subject of water, and of the impression that scientific experts had, that in many places where there was supposed to be a want of water from the absence of rivers appearing above ground, there were underground rivers, and that, if dug for, plenty of water would be discovered. I was struck with that remark, because only a few months ago I was in Bechuanaland, and there my attention was called to a fact, similar in some respects, by the Administrator, Sir Sidney Shippard, who has a very strong impression that in Bechuanaland, which is sometimes very erroneously called a waterless desert, there is plenty of water, which is to be found in these underground rivers. In referring to New Zealand, the lecturer also noticed that it was said that during the New Zealand war the volunteers did very good service on many occasions, and that an opinion prevailed in some quarters that for bush fighting they were better than regular troops. I can only say that my recent visit to South Africa has impressed me with a similar idea in reference to this being the case in wars that are carried on in countries of that description ; and I have come back with the very strong impression indeed, that if in the past unhappy war in South Africa more use had been made of the South African volunteers, a different result might have been achieved. I will only make one further remark in reference to a system of national defence. It is very well for all parts of this great Empire to take every possible step in their power to defend their coasts by the most perfect system of military organization ; but we must, as a great maritime Power, after all place our first line of defence in having the strongest Navy in the world. It appears to me that that is one of the chief points connected with the subject which has incidentally been touched upon—Imperial Federation—namely, that we should have a navy that does not come alone from the mother country, but is an associated navy of the mother country and the Colonies, formed and combined into a great national navy, to which all parts of the Empire, adequately represented, adequately contribute, and in the formation of which, and the policy connected with which they shall have their just and equitable share. And this can only be perfectly and successfully carried out under some system of National Federation.

Colonel F. CARDEW : I understand from Colonel Carré, that in speaking of federation he meant federation as colonies, and not as a separate nation. I think that before you could federate the forces of the different colonies it would be desirable to have a federation of the colonies themselves, because, as we

have heard the lecturer say just now, there are different Acts for the respective forces of the several colonies, and before you can organize those forces together, you must have an uniform Act for the whole. With regard to the organization of the forces, the lecturer stated that Major-General Edwards recommended that they should be organized systematically into brigades. That to my mind is rather a stereotyped idea of things. I think the constitution of the force should adapt itself more to the peculiarities of the country. In Australia, as in South Africa, I think we want less of cavalry and infantry proper, and rather more of mounted infantry. In my own experience of South Africa the mounted infantry seems to be the arm that should prevail, and it is undoubted that in our unhappy war with the Boers the other day, they had a decided superiority over us by reason of their mobility, and the precision with which they fired. Therefore, as I believe in Australia there are many volunteer corps of mounted infantry, I think they should be maintained and encouraged as mounted infantry, that is to say, mounted for the purposes of mobility so as to be carried on horseback rapidly from point to point, but taught to fight on foot as infantry. I remember in this theatre last year, during a discussion which followed a lecture on "Fleets and Fortifications," that Admiral Colomb's idea appeared to be that we were rather over-fortified, and that the money spent on fortifications should rather be applied to fleets. I think up to a certain point that is true, and that in Australia especially they are over-fortifying themselves. We heard just now of the establishment of large batteries of 9.2 and 6-inch guns for defending the different harbours, and of there not being sufficient gunners to work those guns, though it was added that the people are very willing to volunteer for the purpose; but I think when it came to the issue it would not do to rely upon this. I think, therefore, if I may be allowed to say so, that in the organization of the forces of Australia more attention should be paid to having mounted infantry than other arms. The fortifications themselves will always require a large number of troops to defend them who might be better employed in the open field. The Australian colonies, like other young nations, may possibly be ambitious to get large standing armies, but there is one question I should like to ask, which is, where is the enemy to come from? And I think you would find it a very difficult undertaking for a hostile force to land in any part of Australia as long as we have a fleet and maintain our supremacy on the sea.

The CHAIRMAN: We have present two gentlemen who have been immediately connected with the Australian forces, Colonel Owen, R.A., and Major Brownrigg, of the Rifle Brigade. I am sure this meeting will be glad to hear what either or both of those gentlemen have to say upon the subject before us.

Colonel OWEN, R.A.: It is with very great interest that I have heard the admirable paper by Colonel Elias, on the Australian forces. It is an excellent sequel to the paper which was published some few months ago in the Journal of this Institution, by my friend Colonel Disney, R.A., on the force of one of the colonies only. In this lecture Colonel Elias has shown how the several forces stand with regard to one another, and what their total strength would be. With regard to the forces of Australia, he says the militia may be looked upon as their regular force. I think that is rather misleading, although he did modify the statement afterwards. The regular force of Australia is only now growing: it has just begun to establish itself, being in reality the so-called "permanent forces" of the colonies. They have, as you see stated in the paper, about 900 men, who are regular soldiers. These "permanent" forces come, generally speaking, under our English Army Act; they live in barracks, and are distinctly professional soldiers; they are the regular soldiers of Australia, undoubtedly. There is no difficulty so far in getting very excellent men there for these professional forces; they are certainly small in number at present, but it would be easy, I believe, to make them ten times as strong and yet maintain the same physique. There are always men of good character ready to serve; the pay is undoubtedly better than that of an English soldier. The first speaker (Lieut.-Colonel Carré, R.A.) stated that the Australian militia forces are very expensive. As a matter of fact I think you will find that it is a very inexpensive force, as far as payment goes, but the speaker has taken, no doubt, the whole expense, including fortifications, guns, and so on. If you take the expenses of the personnel alone, it is very small. The Victorian militia

soldier costs about 12*l.* per annum, inclusive of his clothing. South Australia, at present, is comparatively a poor colony, and is saddled with that enormous piece of territory you see shown on the map, which is unproductive so far; notwithstanding this, the heroism of a great, young nation is absolutely starting a railway, and has carried it a considerable way up across that desert, while the same colony has already had the glory of carrying a telegraph line right across the great continent of Australia. She cannot afford to spend very much on her forces, and her infantry militiaman costs per annum, pay and clothing combined, about 8*l.*, which I am sure is exceptionally cheap. The admirable qualities of the material constituting the militia soldiers of Australia must have struck any one who has had anything to do with colonial forces: the intelligence of the men, the zeal of the Officers, and the physique generally of the men. As to discipline, I am sure that all Officers who have had to command Australian forces will agree that they are perfectly amenable to discipline. I have had the pleasure of commanding the forces of South Australia for three years, and I found the Officers and men perfectly amenable to strict discipline. The lecturer states that there is no such thing as a compulsory service for the militia, and then he quotes Canada as a good example to the contrary to follow. As a matter of fact in the colonies of South Australia and Queensland the law is compulsory service by ballot for the militia, if the numbers laid down as a minimum are not volunteered for, and further, in case of emergency (by proclamation), a reserve of militia can be obtained, in such numbers as the Government wish to obtain. Not only that, but the law allows these militiamen when so called out to be sent to any part of Australasia, to be placed under other colonial commandants or colonial Officers; so that these two colonies already have a law which enables them to use their militia force as a federal force, acting if necessary in common. The lecturer has referred to the volunteer mounted infantry; it is an excellent force, thoroughly appropriate to the country. In a land where the distances are very great, you have to bring your country forces a long way down to the coast if you want to collect a large number together to resist attack. Of course the best men as to physique will not be those necessarily in the neighbourhood of the large towns, but those who are leading a hardy country life. These are men who are continually on horseback, and excellent mounted infantry they make. When raising such a force for the first time in South Australia, we found that without the slightest difficulty we could obtain comparatively a large number of such corps, had funds been available. A capitation grant of 3*l.* 10*s.* per man and horse was the Government allowance for efficient. The zeal of the men was astonishing. I have known men come eighteen to twenty miles for drill, and go out again the same evening after riding and marching at drill for three or four hours; the harder the work, the better they seemed to like it. In the first year one small body marched down eighty miles in thirty-six hours, and they had not a sore back when they came in. I do not think that force is sufficiently encouraged in the colonies. The great thing after all, with regard to the Australian forces, is that we must not be in too great a hurry. We must not give too much advice to the colonies; we may look upon them as sons, and the old country as a mother, if we like, but when sons are grown up, you know that however good advice a mother may tender, they do not always follow it. It does not seem to me necessary that political federation should come before military federation; there is no reason why the Australian colonies should not act in common for defence, even without such political federation, although we may hope in time some scheme of Imperial federation may become possible. It seems to me that the regular force ("permanent forces") is the first force which the colonies should take occasion to use in common, and I do hope that we shall see the day when there shall be batteries of Australian artillery in England, and batteries of English artillery taking their place in Australia. There will be, no doubt, some small permanent force of infantry formed in all the colonies of Australia. In America, as we know, there are a small regular federal army, and large forces of States militia. I am afraid I have passed the ten minutes' limit of time allowed. I will only add that anybody who has had to do with Australian forces must always take that deep interest in them which I do in those of South Australia, and must see the value which they would be to the colonies themselves, and even to the Greater Britain in time of need.

Major BROWNRIGG (Rifle Brigade) : I think I may say that I am probably the last arrival present from Australia—having only landed in England a week ago. I have heard with great pleasure the lecture of my old friend Lieutenant-Colonel Elias, and can thoroughly endorse everything he has said. There is one point in his lecture, however, I should like to have seen a little more stress laid upon, and that is the utter want of unity in military matters in Australia. Every Colony raises its own little army, and visitors are surprised at the small but well disciplined permanent forces, at the excellency of the infantry, the well-trained garrison gunners, the superior field artillery, the advanced state of the engineers, whether field or submarine, and, above all, at what may be called our essentially Australian type of troops—the mounted rifles; but there is no military unity whatever between the Colonies. Each body of troops serves under a different Discipline Act, is raised in a different manner, the pay is dissimilar, they are armed differently, and, I am sorry to say, even the manner of drilling does not always agree. In Victoria, and, I believe, in the other Colonies, no militiaman is bound to serve outside his own Colony. Every Colony has an elaborate scheme of defence, but only as far as its own shores are concerned. Preparations are made for the defence of Melbourne, Sydney, Adelaide, Brisbane, &c., both by land and sea, but the idea of one Colony supporting or giving assistance to another is, I believe, scarcely touched upon. In fact, the Australian Colonies are inclined to look upon one another very much as France or Germany look upon Belgium. Of course this want of unity causes, whenever there is a chance of England being involved in war, what Major-General Edwards calls in his report “unseemly war scares,” when money flows like water, and it is too late to carry out anything but hasty reforms. I think Major-General Edwards’s proposal, of units consisting of brigades of all arms, each Colony to raise from one to three of such units, an excellent idea, and I sincerely trust it will be carried out. There does seem now a little chance of some unity being established between the Australian Colonies, and I trust the meeting which is to be held shortly in Melbourne will give sufficient prominence to military unity. As Colonel Owen has very properly remarked, the Colonies do not like to be dictated to; but this is such an important question, viz., the safety of Australia, that I think (with all respect be it said) a little more pressure might be exerted by the Home Government than has hitherto been done. It seems a great pity that these fine Australian forces should remain in what I may almost call a recruit stage, or like the proverbial bundle of sticks, easily broken singly, when together they might form such a compact body. Of course if a war were to break out, and the danger of an invasion of Australia imminent, some sort of union in military matters would be established on the spot, but it would have to be done in a hurry, would probably be faulty, and would, certainly, be most expensive. In my humble opinion, a General Officer of experience should at once be sent out to Australia. This Officer should be under no particular Colony, but should inspect the forces of each, and give advice to the Governments—which advice, I am sure, would be followed whenever practicable. In time of war he would, of course, assume the exclusive command of all the Australian forces. I must state, in conclusion, that the great want of military union in Australia is thoroughly felt by all military men in the Colonies; and I am glad to say that the usual petty intercolonial jealousies are, as far as I can see, quite unknown among the soldiers of Australia. I have lately had the opportunity of discussing this question with all the military commanders of Australia—with one exception; and I think I may say they quite agree with the remarks I have just uttered; and, if it were in their power to create an united Australian force, it would be done in half an hour.

Colonel J. F. OWEN : I hold in my hand what I look upon as the germ of future common action by the military forces of Australia. It is the Report of the first Annual Meeting of the General Council of the Rifle Associations of Australasia (including Tasmania). I think it is a most satisfactory commencement of working on a common basis. These rifle associations are composed of members of the various forces of the several Colonies.

Lieutenant-Colonel HUTTON : There is one point to which I venture to call attention. The lecturer has alluded to Mounted Rifles and Mounted Infantry in a manner which might lead to misunderstanding. The two things, according to our

understanding of the subject here in England, are absolutely distinct. Mounted Infantry or Mobile Infantry are infantry soldiers, pure and simple, who are mounted for purposes of mobility only upon any animal that may be most suitable to the country and to the campaign in which they take part. The corps which is advocated by Colonel Owen, Major Brownrigg, and by the lecturer, and which has been raised by the Australian Colonies, so far as I have been told, are Mounted Rifles. Such a force, though intended to act on foot, has duties and functions which are not included in the rôle of the mounted infantry soldiers, who will, in our future campaigns, be given such means of locomotion as may be required to enable them to act as infantry in concert with cavalry. In Australia there are, as I understand, no cavalry, consequently the corps of Mounted Rifles will have to perform such duties as usually fall to the lot of cavalry in war. Such duties Mounted Infantry are not intended to perform. It was the confusion in the use of the two terms which I wished to make clear.

Major BROWNRIGG: They are mounted infantry in Victoria.

The CHAIRMAN: Ladies and gentlemen, at this hour of the evening it would scarcely be proper that I should detain you at any length with remarks of mine. Were I to do so I should probably overstep your dinner hour, for during the last twelve years the question which is before us to-day has been one of the principal objects of my attention. I was asked so far back as 1877, when I was Governor of the Straits Settlements, to go to the Australian colonies to advise their several Governments as to the steps which I would recommend respecting their defences, and I did so. It so happened that the Government of one of the colonies fell vacant just about that time, and I remained in Australasia from that date until March last, first as Governor of South Australia, then as Governor of New Zealand, and have been more or less the adviser of the Australasian Governments in matters relating to their defences from that time until I left the colonies. The question which the lecturer has put before us is a very large one. He dwelt mainly on what may be termed, for distinction, the land defences. You will observe that he did not enter into the naval question. Now, I venture to think, as one speaker has observed, that this is really more a naval than what we ordinarily term a military question. If Australia is not part of the British Empire, if she is not defended by the British fleet, she cannot hope to remain Australia; she may be attacked by other great naval Powers; by Russia, by France, perhaps by the United States, by Germany, and slices may be cut off here and there. It will be impossible for a country which at present only has a population of about three millions to hold that enormous continent, which is about the size of Europe, against the forces of one of the great naval Powers, with a population of about forty or more millions each. Besides the question of the defence of Australia, there is also that of the organization of its forces for other purposes than for its defence. But the question of the organization of the forces for those purposes must be left until the time, as one speaker has justly mentioned, when Australia becomes a federated country, when all its business can be dealt with from one focus, and when, amongst other causes, by reason of their increased population and their increased revenues, the Federal Government may desire to take part in military operations which may be undertaken by the British Empire in any portion of the globe. But, as I said before, the defence of Australia is mainly a naval question. When I was sent there in 1877, I of course had to make reports to the various Governments. Those reports may now be seen, and that paragraph, which my friend the lecturer did me the honour to read, and which is designated as a speech made in 1884, was really an extract from a report made in 1877; and I do not mind saying that at the time when I was called upon to report to the Australian Governments with reference to their defences, I had much more trouble in making up my mind to that paragraph than to any other portion of the document. The difficulty was to show how Australia could probably be attacked. You see the distances the lecturer has mentioned from possible hostile ports to Australian harbours—distances of thousands of miles. When we think of our squadrons and fleets in every portion of the globe, when we think that we are to have an Australasian naval force capable of dealing with any hostile force that may make its appearance in Australasian waters, when we think of the defences of Melbourne, Sydney, Adelaide, Auckland, and so forth, we must see that they all

form part and parcel of the naval defence of Australasia, just as the defences of Portsmouth, Plymouth, Pembroke, and Cork are part and parcel of the naval defence of Great Britain and Ireland. That is not generally understood. People talk about the matter as being under two categories: they speak of the Navy as one thing, and the forts of Portsmouth, Plymouth, Malta, Melbourne, Sydney, Auckland, and other fortified places as another. Why, they are all part and parcel of the same thing, viz., the naval defence; so much so, that I have heard it said by people who have experience in these matters—and I must say I am disposed to agree with them—that it is a question whether those defences should be under the Admiralty instead of under the War Office. I am speaking as a person who has had to deal with these things now for the last thirty-five years, but, having been absent from England, I have not thought it desirable to take part in the various discussions which have arisen on the question. I am sure that the minds of the people of England generally will be right upon the subject, and that the minds of those naval men who understand the question thoroughly are in accordance with the views that I venture to express. The question before us is really this. We want first and foremost forces to hold the fortified ports of Sydney, Melbourne, and the rest, and to work and defend the batteries erected for the defence of those ports, where the fleet will coal and refit. At the same time I may observe that the defences referred to protect the centres of wealth of the colonies concerned against any naval attack that might be made by cruisers that may elude the vigilance of the British squadrons. That is the real position. Then what is the force wanted? You want first of all permanent artillery, which has been referred to by Colonel Owen; you also want submarine miners. You want a certain number of infantry to co-operate with the artillery. You want also, according to the nature of the country, a certain number of mounted infantry, to aid in the defence of the coast about the fortified places. If you go beyond that, you get into another category. Contrary, I know, to the opinion of many, I do not concur in the idea of forces proceeding from Brisbane to Adelaide, for instance, to co-operate in the defence when there is a liability of attack from a naval force anywhere. I do not believe men will go from Sydney to Melbourne, from Melbourne to Brisbane, from Brisbane to Adelaide, for the purpose of co-operating in the defence; and what is more, I do not think they should. The fact is that, in my judgment, these proposals for the amalgamation of forces, however desirable in themselves, are not germane to the point first to be considered. These proposals, however, *do* come into play with reference to the creation of a force which shall be capable of co-operating with the armies of the British Empire generally, and which, as the population of Australia increases, and as her revenues increase, shall be able to take part in any war in which the British Empire may be engaged. Although it may be gathered that I to some extent express disagreement with the views very commonly entertained on these matters, yet still I do look forward to the time when there may be such a force. I look forward to the time, and no one has advocated the measure more strongly than I have, when there may be an Imperial federation, when there may be a federation of the Australian colonies, and when British ships will fight alongside of Australasian ships, and Australasian land forces will co-operate with British troops in doing battle with the common foe.

I am sure you will all agree with me, that our warmest thanks are due to the lecturer for the able and thorough way in which he has placed his views before us.

Wednesday, January 22, 1890.

REAR-ADMIRAL P. H. COLOMB, Member of Council, in the Chair.

THE TACTICS OF COAST DEFENCE.

By Lieutenant-Colonel WALFORD, h.p., R.A.

PART II.—*Organization.*

IN a paper "The Tactics of Coast Defence," which I had the honour to read in this theatre in May last, I endeavoured, by founding my theory upon the probable tactics of offence which would be adopted by a naval force when attacking a coast fortress, to deduce from these the corresponding tactics of the defence. During the discussion which followed the reading of the paper, I was accused by the late Major G. R. Walker, R.E. (an old personal friend of my own, and an Officer whose premature death many of us most deeply deplore), of taking a too narrow view of the meaning of the word "tactics," and I acknowledged that the sentence which he quoted might be considered to justify his accusation; but I submit that the fact that the careless wording of this sentence was a mere error was sufficiently proved by the efforts which I made to show that the scheme of defence of a port or harbour must, if it is to be really effective, be carefully considered beforehand from a tactical point of view, and that in a large proportion of cases, if it be skilfully carried out, and if the scene of action be naturally favourable to the defenders, it may be not only possible but easy to deprive the assailant of his initiative, and to compel him to proceed by stages which we have beforehand anticipated and provided for.

I at that time ventured to offer for the consideration of my audience certain general principles for the defence, more especially with regard to the reciprocal action of the various factors of which it is composed, and I will ask you to bear in mind that for this purpose I divided the subject into two parts, viz. :—

a. The active defence; consisting of such ships, torpedo-boats, &c., of the Royal Navy as might be detailed to the particular harbour in question.

b. The passive defence; consisting of—

- i. The guns.
- ii. The submarine mines.
- iii. The torpedoes.
- iv. The water defences; such as guard-boats, &c.
- v. The electric light.

If my paper in any way fulfilled my intentions when writing it, it made one fact perfectly clear, viz., that any system of defence which is to have even a fair chance of success must be based upon the co-operation of all these several fractions. Combination and concentration of energy must be provided for, not only between each factor of the defensive strength, but also between every unit of each of these factors.

This union of the efforts of many for the accomplishment of one single object can be effected only by means of a systematic chain of responsibility and command, of which each link shall be independent within its own sphere, but shall be subservient as a unit to the general purpose. I propose therefore to commence my paper of to-day by discussing what should be the organization of the system of command in a coast fortress, and to add some notes on the duties of the various grades of Commanders.

Before proceeding further I will ask you to allow me mention two points, viz. :—

a. I do not propose while stating my system to refer to any existing fortress. It would be undesirable in many ways, and it would moreover be inconvenient, to do so, since principles may be general in their application without being of necessity universal, while the local peculiarities of each particular place will certainly enhance the value of some at the expense of others.

b. In the discussion which followed the reading of my last paper, attention was drawn to the fact that I had said nothing whatever of the action of land forces against a coast fortress, but had confined myself to the consideration of the action of a naval assailant.

This omission was intentional, for the reason that these two fractions of the defence of a coast fortress are entirely distinct. They differ in armament, in the character of the works employed, and in the conduct of the attack and defence. The system of working the land front of a coast fortress would, I submit, come rather under the head of Siege Tactics, into which I do not desire to enter. I therefore, on this occasion also, propose to pass over the question of the land defence, and to confine myself almost entirely to action against a naval force.

I. The System of Command in a Coast Fortress.

This should, I think, like all other systems of command, be based upon the principle of the undisputed authority of the superior Officer over each of the complete units which make up his command, combined with the almost absolute independence of the Officers commanding those units within the limits of their command. In other words, while it is imperative that the superior shall have the power to order the inferior to carry out his wishes, it is not desirable that he shall bind that inferior as to the means by which those commands shall be obeyed; instruction and practice in the correct execution of orders should form a part of the system of training in time of peace, and should not be either given or required when in the presence of

the enemy. A distinction must be drawn between an "order" and a "word of command;" the latter must be obeyed to the letter, but mechanically, the former in the spirit and intelligently.

If this quasi-independence be not admitted the chain of command ceases to exist, and all responsibility, including even that connected with technical matters, rests as a load on the head of the senior Officer, and tends to unfit him for the decision of important issues. If it be admitted, we shall find that Officers of energy and intelligence will, since they will not be required to concern themselves with merely technical details, be competent to train *for* war, and command *in* war, troops of whose special instruction they may have but little knowledge. Such an arrangement may even be beneficial to the troops in question, as tending to liberate them from the bonds of that corps routine which is the consequence of an exclusive devotion to the study of one arm of the Service. Have we not all at some time realized how difficult it is for senior Officers to learn not to interfere with the execution of subaltern duties, or even to cease to busy themselves about such minor details as may be best left to the omniscient eye of the sergeant-major? Many of you will, I think, agree with me when I say that ignorance of detail has its advantages if it enables us to take a wider view of a question as a whole.

The chain of command which I propose to offer for your consideration may be summarized as follows:—

- a. The Commander of the Fortress.
- b. The Commanders of Defences.
- c. The Commanders of Sections.
- d. The Commanders of Units; such as forts, batteries, mining and torpedo stations, &c.
- e. Commanders of groups of guns, or (generally) of fractions of units.

a. The Commander of the Fortress.

The supreme command of a fortress must be vested in one head; the concurrent authority of a military and a naval chief would be inadmissible; but, following the principle which has just been stated, there appears to be no reason why such a command should not be entrusted to an Officer of either Service, with the proviso that, for causes connected with discipline, some attention should be paid to the relative strength of the naval and military forces in the command.

The Officer commanding a fortress would have charge of the general conduct of the defence (including, where necessary, the government of the civil population), and of all communications with the enemy; he would be the head and the heart of the defence, but it would be well that he should not endeavour to be the hands also.

b. The Commanders of Defences.

The total defence, like the total circuit, of a coast fortress divides itself naturally into the following:—

- i. The active, or sea, defences.
- ii. The passive, or coast defences.
- iii. The land defences.

And each of these must be under a separate command, while under certain circumstances, such as great extent of site, the command of the two latter may be necessarily again subdivided.

Their duties, each in his own sphere, will be to provide for the due execution of the orders given by the Commander of the Fortress; generally speaking, they will knit together for combined action the various sections which are under their command.

c. The Commanders of Sections.

Considerations connected with site and the need for a closer supervision than can be given by the Commanders of defences will render it necessary to divide the entire circuit of the fortress into sections, and to appoint to each of these a Commander, who shall arrange for the combined action of all the units which compose it in such a manner as may best carry out the intentions of the Commander of the fortress, which will have been explained to him by the Commander of the particular defences under which the section may come.

d. The Commanders of Units.

Within the limits of the coast defences (which alone I now propose to consider) these will be as follows:—

Artillery.

- i. Officers commanding the main forts and batteries armed with heavy and medium guns.
- ii. Officers commanding the batteries of guns intended for high-angle fire.
- iii. Officers commanding the light armament, provided for the defence of mine-fields.
- iv. Officers commanding the movable armament, consisting of field artillery.

Engineers.

- v. Officers in charge of submarine mines.
- vi. Officers in charge of torpedoes.

Other Arms.

- vii. Officers in command of detachments of infantry.

All the above, when present, should be under the command of the Officer commanding the section.

It will be observed, however, that I have here omitted two very important units, viz., the Officers in charge of the electric light and the Officer in command of the water defences, consisting of guard-boats, &c.

With regard to the former of these I am, as I have before said, distinctly of opinion that the electric light should in all cases be under the orders of the Officers commanding artillery units, as it is far more urgently required by them than by the Officers in charge of submarine mines.

The use of the guard-boats, steam-launches, &c., which make up the water defences, cannot, I submit, be limited to any one section, though each should, if possible, have a few boats told off to it. The number of available boats will, however, almost certainly be insufficient for the full supply desired, and this force should therefore be employed rather for the advantage of the whole system of defence than for that of any one fraction. For this reason I consider that the direction of the action of the water defences should be placed in the hands of the Officer commanding the coast defences, and not in those of any local authority.

To the Commanders of units named above should be committed all matters connected with the technical duties of their several arms. With the possible exception of the artillery movable armament (which it might be convenient to associate in one command with the infantry of the local reserve), they must, if only on account of the distance which will divide them, be each independent of the others as regards the actual working of their commands. It is the duty of the Officer commanding the section to issue such orders as shall ensure the combination of their efforts to a common end.

It will be convenient that Commanders of units shall be told off permanently not only to a section, but also to a particular portion of that section; they will thus be in a position to make themselves masters of the local peculiarities of their stations.

e. Commanders of Subdivisions of Units.

These will be the junior Officers of each arm, such as the Commanders of groups either of guns or mines; they will be responsible for the state of preparation and the efficient working of their respective commands, and will attend to minor details of equipment, the supply of ammunition, stores, &c.

It is evident that Officers of this class, as well as of that which immediately precedes it, will be concerned rather with drill than with tactics, since their duty is merely to carry out such orders as they may receive in accordance with the best technical method of their respective branches of the Service.

II. The Duties of the Various Grades of Commanders in Anticipation of an Attack.

a. The Commander of the Fortress.

This Officer should, on taking over his command, make himself acquainted with the topography of his defences, both land and submarine, and should further master the tactical reasons for their

existence and for the selection of their localities. He should revise the system of division into sections, and should select his Commanders of defences and sections.

Having obtained all possible information as to the probable strength and composition of his garrison in case of war, he should distribute the troops among the sections in accordance with their requirements and importance, taking care, however, to retain under his own command some distinct portion of troops (of all arms) as a central reserve. These details of preliminary organization, though very simple on paper, would, I may add, be attended with some little difficulty in the case of one of our home fortresses, owing to the mixed composition of their garrisons, and to the conflicting claims of Officers of the Regular and Auxiliary Forces of various degrees of seniority.

Having (probably in concert with the Commanders of defences) decided upon his plan of defence, he should direct these Officers to explain it to, and discuss it with, the Commanders of sections, reserving to himself the power to make any changes which may be rendered necessary by some unforeseen peculiarity in the enemy's mode of attack.

The Commander of a fortress should further examine and approve all general plans connected with the supply of the troops and with the provision of hospital accommodation, &c.; he will, moreover, have to deal with that extraordinarily difficult matter, the provision for the due government of the civil population.

b. The Commanders of the Sea, Coast, and Land Defences.

Of these I propose to omit the last, as his duties lie outside of the limits which time obliges me to set to this paper; while of the Commander of the Sea Defences it will be sufficient to say, without entering into the technicalities of his service, that his task will be simple as compared with those of the two others, since his ships, with their armament and crews, may be taken to be permanently on a war footing and in a state of adequate preparation.

The Commander of the Coast Defences (or each of the Commanders if there be more than one) should have authority from the Commander of the fortress to rearrange minor points with regard to the distribution of the garrison to the several sections, and should moreover be empowered to give effect to the recommendations of the Commanders of sections, with regard to the armament, &c. He should personally inspect and approve all matters connected with the housing of the troops in their various sections, and should have entire charge of all questions connected with supply, hospital accommodation, and the administrative departments within his command.

As has been already mentioned, he will be specially responsible for the recruiting and organization of the water defence.

On the completion of the preparations for defence, he should personally inspect all the sections of his command, and should

ascertain that their Commanders comprehend clearly the parts which they are severally to play in the defence both by day and night.

I am of opinion (but I state this subject to correction) that this Officer should be responsible for the decision as to the moment at which the submarine mines should be laid down; the question seems to rest between him and the Commander of the fortress (who may be called upon to direct special attention to the land front), and should certainly not be left to the Commanders of sections, whose action, though general for their section, must be local as regards the defence as a whole.

c. The Commanders of Sections.

Each of these Officers should be responsible for the complete efficiency of his command as regards organization and readiness for action; he should inspect every portion of it, and should further, if time permits, work his section as a whole with some definite tactical object. He should arrange for the reciprocal assistance of units to each other in battle, and should be encouraged to suggest (and if necessary to initiate) such changes within his command as may tend to facilitate concerted action.

Assuming, as I propose, that the duties of the Commander of a section are limited to the efficient tactical conduct of the mixed force which is under his command, it is, I submit, immaterial to which arm he may personally belong; but, on the other hand, it is most essential that he shall study the tactical conditions on which the scheme of defence of the particular fortress is founded. He should moreover fully understand the position of his section with regard to those which adjoin it, the manner in which assistance can be best rendered to his neighbours, and the part which he is himself expected to take in actual battle.

He should therefore make himself intimately acquainted with the details of locality and armament of his section, and of such other sections as he may be called upon to assist; he should, further, study the position of all channels by which the enemy may advance, and should know the depth of water in them at all times of tide. The limits of bearing of the guns, &c., and also the boundaries of the mine-fields in his command, should be laid down on a large-scale chart, together with any other information which may possibly be of use.

He should, on taking over his command, at once distribute the garrison allotted to his section among the various units, keeping back a small reserve (of all arms), for the purpose either of replacing casualties, or of reinforcing any specially threatened spot; he will in doing this avoid, as far as possible, breaking up any units of peace organization.

He should encourage the Commanders of the various units under his command to concert among themselves the means which they would take to afford mutual aid; but he should require that all such arrangements shall be submitted to him for his approval, in order that

he may ensure that no individual fancies shall interfere with the general scheme of defence. From these suggestions he may draw out a rough plan of action, but, since any such plan must be liable to alteration, the details should not be laid down on hard and fast lines, but should be merely provisional.

He should select for his headquarters some spot which can be easily placed in communication with the various units of his command, and from which moreover he will be able, in case of attack, to observe and direct the working of his forces.

All administrative details of his section will be in his charge, and it will be his duty to arrange for the distribution of supplies to the several forts, &c., and for the selection and preparation of some central post as a hospital of the 1st line. He must with this purpose be supplied with a staff consisting of a representative of each department.

d. The Commanders of Units.

Since while examining this portion of my subject it will be necessary to go a little more closely into detail than I have as yet done, and since in the time at my command it will be impossible to do so for all the units which I have mentioned on an earlier page, I propose to speak under this head of only such duties as should be discharged by the Commanders of artillery units; but, in so doing, I shall as far as possible use general terms, in order that the Officers of other branches may apply the same principles to their own arms.

The duties of a Commander of an artillery unit will be as follows :

i. He will divide his force into two (or, if possible, into three) reliefs, and will take care that every man of each relief knows exactly what should be his position and his duty in case of alarm; with this object the troops should be practised in taking post both by day and night. Each relief should have a strength of about 10 per cent. above the amount actually required for the service of the guns, in order that casualties may be replaced without delay. This extra percentage should be kept up by drawing on the sectional reserve, and in no case by withdrawing men from the other relief, which should be preserved as far as possible intact.

No advantage would be gained by keeping the reliefs which are off duty in the fort during the continuance of the action, while their presence there will certainly lead to unnecessary casualties; it will therefore be advisable to provide some shelter near the fort or battery in which the second relief may cook, sleep, &c., until required.

ii. The armament of the fort or battery should be divided into groups (if this has not already been done), according to the calibre or the bearing of the guns; each group should consist of from two to six guns, and should be placed under an Officer if one be available.

iii. The Commander of a fort should carefully inspect every article of the equipment which is in his charge, and should prepare the whole for action. For example, he should see that all shell are filled, and that a certain proportion are brought up to the guns, that cartridges are made up, fuzes ready to hand, range-finders in order,

buffers filled, side-arms in good repair, signalling arrangements perfect, and that the lifts and magazine lights are in good order.

When possible arrangements should be made (which in some of the old forts will be difficult) for the separate and independent supply of each group with all requirements. The group, and not the single gun, should in fact be taken as the smallest tactical unit, and should therefore be made as complete as possible.

iv. Each Officer commanding a fort should be provided with a large-scale map of the portion of the fortress which is within the immediate radius of his action, and should on this make such notes as may be of use to him. He should, for example, mark on it the limits of bearing of each of his guns and groups of guns, the bearings of the mine-fields, the course of the channels to be defended, and the boundaries within which the water defence will be able to act.

This map should be mounted on a plane-table, and should be furnished with a sighted pointer, pivoted on the position of the fort on the map, and graduated to hundreds of yards; around the position of the fort, as shown on the map, should be described a circle of about 1 foot in radius, on which should be marked off graduations showing degrees of bearing from the true north. In forts where (as we may hope will generally be the case in future) the Commander has a station beyond the boundaries of the work, a second pointer, also graduated in hundreds of yards, should be pivoted on the spot on the map which corresponds to his post.

Care should be taken that every Officer commanding a group is acquainted with the appearance, name, and range of any conspicuous objects, such as rocks, &c., which may be visible from the fort.

v. Arrangements must be made for receiving, storing, cooking, and issuing the supplies received for the garrison; the post which has been selected to shelter the relief will be the most convenient for these purposes. Some portion of the fort must be selected as a hospital, and a system must be laid down for the removal of the wounded from the batteries, as well as for their transport to the ambulances which will be sent by the section Commander to receive them.

e. Commanders of Subdivisions of Units.

It is obviously impossible to describe the duties of the junior Officers, such as the Commanders of groups and the corresponding subalterns of the other branches of the Service, without entering into a mass of technical detail which would be more in place in a professional manual than in such a paper as this.

III. Systems of Supply, &c.

It may perhaps, however, be advisable that I should here give a slight sketch of the system suggested for—

- i. The supply of the troops.
- ii. The transport of wounded.
- iii. The replacement of casualties.
- iv. The renewal of ammunition.

i. Without entering into the question as to the original source of supply, whether from magazines, from the surrounding country, or by rail from a distance, it will be sufficient if we here consider the means of the distribution of supplies to the troops. These might be roughly arranged on the following lines:—

a. At headquarters of fortress, supplies received, stored, and issued to staff of land and coast defences.

b. Transport of defences distribute to sections.

c. Transport of sections distribute to units.

d. Units provide for cooking and issuing to men.

ii. *The Evacuation of the Wounded.*

This will be carried out through the same chain, but in inverse order, as follows:—

a. Commanders of units arrange for delivery at the gate of the fort.

b. Collected by section ambulances, and taken to hospital of the 1st line.

c. Passed on, as may be most convenient to the local and, if necessary, to the central hospital.

iii. *The Replacement of Casualties.*

It has been already suggested that each relief shall have a strength of 10 per cent. above the number actually required for working the guns; the same rule should probably apply to the units working submarine mines, but this addition will not be necessary in the case of infantry.

With respect, therefore, to the artillery and engineers of the defence, the system will be as follows:—

a. Casualties in detachments made up from extra 10 per cent.; never, except in cases of extreme emergency, from the other reliefs. But, if the Commander of the unit shall consider it desirable, he should be permitted, when the unit is actually engaged, to call up the extra 10 per cent. of either or both of the reliefs off duty.

b. The extra 10 per cent. to be kept up from the local reserves of sections.

c. These last to be filled up from the reserves of defences.

d. The reserves of defences to be reinforced, with complete tactical units, such as companies, batteries, from the central reserve.

e. Infantry may be *reinforced* by companies from any one of the reserves, but should be always *relieved* by battalions, and never by detachments from other battalions.

iv. *The Renewal of Ammunition.*

Omitting the question of the supply of ammunition to the guns, as not coming under this head, it is evident that, if magazines be available for the storage of powder, &c., within the various defences

and sections, its renewal might be arranged on the same general system (though, of course, with distinct transport) as has been suggested for the distribution of supplies.

As, however, such magazines will rarely exist, it will as a rule be necessary to provide for the renewal of ammunition from the central magazines of the fortress on requisition from the Commanders of sections, forwarded through the Commanders of defences. In cases of emergency, the latter should be permitted to sanction the issue of ammunition to any fort in action from any other which is not likely to be engaged. Arrangements should be made for the transport of ammunition, in addition to the amount required for the carriage of supplies.

IV. *The Duties of the Various Grades of Commanders during the Progress of an Action.*

a. *The Commander of the Fortress.*

A little consideration of the tactical conditions of the defence of a fortress will enable us to see that the position of this Officer is very different from that of a General in command of a field army which is standing on the defensive. In the defence of a coast fortress (omitting that of the land fronts), by far the larger proportion of the available force will be absolutely without mobility, since the guns, mines, and torpedoes will be fixed in localities long previously selected, and thus all power of movement, and therefore of counter-attack, will be limited to—

- i. The sea-defence.
- ii. The water-defence.
- iii. The infantry of the coast defences.

While of these the offensive power of the second will be very limited, and that of the last will be available only in the case of a landing by the enemy.

On the other hand, the assailant will, except in the attack of an open roadstead, be compelled to advance on lines which will have been realized and studied beforehand, and will thus cease to possess that initiative which conduces so much to the advantage of the attack, but which is only possible on the supposition that there is no limit to manœuvring; moreover, the locality of the several defences, and the character of their armament, will have been selected with especial reference to the foreseen (and almost obligatory) nature and direction of the attack.

Since, for the above reasons, the strokes and counter-strokes of the attack and the defence will, in most cases, proceed in more or less regular sequence within hard and fast lines, it follows that the share in the defence which falls to the Commander of a fortress will find most of its active expression before the actual commencement of the combat; no new decision or plan will, as a rule, be required from him, except in so far as it may become necessary, during the course of the action, to replace or reinforce the old defences by new works, guns, or mines.

We may therefore sum up the duties of this Officer as follows:—

- i. The consideration and approval of any measures of the counter-attack which are proposed for the sea-defence.
- ii. The suggestion or approval of any counter-attack by the land forces which may require the assistance of the central reserve.
- iii. A decision as to any enlargement or variation of the scheme of defence which may become desirable, owing to the partial success of the assailant.

b. The Commanders of the Sea and Coast Defences.

In the case where the Commander of the fortress is a military Officer, it is very desirable that the Commander of the sea-defence should be not only permitted, but encouraged, to make suggestions with regard to the use of his command, and to point out such opportunities as may arise for its use against the enemy; he should always be consulted with regard to the time and dispositions for any counter-attack by sea.

The Commander of the coast defences will, in addition to the general charge of the whole of the coast forces, have under his direct command—

- i. The local reserve.
- ii. The movable artillery armament.
- iii. The water-defence.

It is not necessary to say more of the local reserve than that it will be employed to resist boat attacks and landings in small force, and also to provide for such a system of outposts as shall prevent the possibility of a surprise by night. The movable artillery armament will as a rule be associated with the reserve in the discharge of these duties; it may also be required to assist the light armament in the protection of mine-fields, in which its mobility, and consequent power to change its position, will be of great advantage.

The Commander of the coast defences should devote especial attention to the water-defence, since, not only is it the only part of his command of which the work is not to a great degree cut and dried, but it will moreover be a matter of peculiar difficulty to so combine its activity with that of the submarine mines and the light armament that it shall neither suffer from, nor interfere with the action of these units.

It would at the same time be very undesirable to limit his duty to the conduct of this small fraction of the defence, and he should be expected to issue orders on his own authority to the Commanders of sections, if he considers that any one of them may be better employed, or if unforeseen circumstances should compel any change in the details of the defence.

He should indeed exercise supervision over the whole of the general conduct of the action, and should be present in person near the point of the main attack, in order that any changes in the programme of defence, which may become necessary, may not be delayed owing to the obligation to obtain his approval.

c. The Commanders of Sections.

The defensive action may, for these Officers, be in most cases roughly divided into three phases, viz. :—

- i. The period of high-angle fire.
- ii. The defence of the mine-fields.
- iii. The close fighting of the forts and batteries.

Of these the first will, as a rule, be completed in each section before the two last commence, though the high-angle fire of collateral sections will frequently be able to afford great assistance to the unit immediately attacked. Except in this last instance, the high-angle fire will thus be entirely independent of the other units of the section, for their co-operation (unless a very advanced system of mines be employed) will generally be out of the question.

The second phase includes the combined action of the mines, the light armament, and (occasionally) some portion of the main armament. It is evident that a guiding hand is thus most necessary to enable them to work together in harmony. It should be remembered that this phase is almost certain to take place at night, and arrangements should be made accordingly.

After the destruction of the mine-fields, and (perhaps) the silencing of the light armament, the main attack at decisive ranges will commence. The Commander of the section should have made preparations for this by, if possible, laying fresh mine-fields under cover of the main armament; if this be not feasible, a moderate use of dummy mines might tend to cause the enemy to hesitate or to move with caution.

The guns and the torpedoes will, however, be the principal arms employed during this phase. The skilful combination of the fire of the former upon both moving and anchored targets will be the main duty of the Commander of a section, and to this matter he must give his full and undivided attention. I submit, therefore (I speak on the subject with great diffidence), that, as a general principle, the Commander of the torpedo unit should be allowed entire independence as far as regards practice at moving ships, for which the opportunities will be of short duration, but should be directed to combine his action with that of the guns when the enemy anchors. I would further suggest that it be accepted that, in the absence of special instructions from the Commander of the section, it is the duty of each unit to engage that ship of the enemy which is the nearest to it at the moment.

It is the duty of the Commander of a section to direct the action of each of the units under his command upon such objects as he may deem it of importance to engage; in selecting these his orders should be based upon the knowledge which he possesses of the power, both as regards range and bearing, of the various fractions of his armament, while he must further provide that the tactics employed are based upon the spirit of the orders of the Commander of the fortress. He must, moreover, arrange to render due assistance to collateral sections of the defence by the action of such units of his command as may be able to afford it.

These duties of conduct and supervision may, perhaps, be best carried out if the Commander of a section avoids the identification of himself with any one unit, and preserves during the progress of the attack that central position which he has previously selected for his headquarters. From this point he will be able to direct all, while preserving himself from any risk of interfering with the technical duties of any; such an arrangement would also be very advantageous as regards facility of communication.

Again, being thus apart from the noise and confusion of the action, he will be able to realize clearly the tactical phases of the struggle, and will thus be in a position to make timely preparation for such changes in the contest as may appear to be imminent; thus, for example, he will be responsible for immediately reporting to the Commander of the coast defence any attempt of the enemy to land or to attack by boats, and for making such dispositions to resist it as may be in his power.

As an example of the limitations of his duty, I will refer to that portion of it which concerns the artillery; thus, he would be responsible with respect to this arm for the direction of the fire and the selection of the target, while the choice of the projectile to be used, the rate of fire, and such other technical matters, should be left to the Commanders of artillery units.

d. The Commanders of Units.

If I may recall to your recollection the list of units which was set forth on an earlier page of this paper, it will be evident that it is impossible, in the time at my disposal, to enter into particulars with regard to each, even if my technical knowledge would suffice for the purpose. I do not propose to examine such details even with respect to the artillery, for the further reason that I do not feel sure that this is altogether the place in which to discuss matters of such limited interest; limited, I mean, as regards the number of Officers concerned, for I have no doubt whatever that a paper which should deal with even the most minute details of the effective conduct of coast guns in war would be of very great value, especially to Officers of volunteer artillery. But I am afraid that an audience composed of Officers of all arms might find such a paper not only disagreeably technical, but appallingly dull. A systematic arrangement of these details, grouped under the various conditions of the defence, would be more in place in a technical manual, where it would form a syllabus of military training, as distinguished from mere drill.

I propose, therefore, with your permission, to limit myself to the mention of a few of the principles which should, in my opinion, guide Commanders of units when in action. These are—

- i. There must be absolute and immediate obedience to the spirit of the orders and instructions transmitted by the Commander of the section, who alone is able to judge of the relative importance of the various targets.

ii. Ammunition must be carefully economized, both with respect to the rate of fire and also with regard to effective range.

iii. Smartness and decision in the selection of the projectile and in the orders given are most necessary; hesitation entails not only loss of time by the Officer, but also loss of confidence by the men.

iv. It should be remembered that the duty of a Commander of a unit is to fight only; he has nothing to do with tactical combinations, which must be left to the Commander of the section, who alone is responsible for the proper selection of the object of the action of his command.

v. The Commander of a unit has therefore no right to change his target without having received orders to do so; if this were permitted, it would lead to the frittering away of fire at the discretion of irresponsible Officers. He is at liberty however to draw the attention of the Section Commander to any change which may appear desirable.

e. Commanders of Subdivisions of Units.

The reasons which I have given for not entering into details connected with the Commanders of units will apply with even greater force to the duties of these junior Officers; there are, however, two points which call for remark, namely, the supply of ammunition and the replacement of casualties within the fort, battery, &c., while actually engaged.

When the Commander of the unit is posted in a station beyond the limits of his command, it will obviously be impossible for him to attend to these matters: while, even if we suppose him (which I am loth to do in the case of artillery) to be actually present with the guns, his attention will be so taken up by his sole duty, the conduct of the fire, that he will have no leisure for minor matters; it follows therefore that these must be left in other hands.

In small forts, &c., such details might be left to the Commanders of groups and their representatives in the Engineers, but in the case of large works it will be necessary to tell off a special Officer to take charge of these and other cognate matters within the fort; this Officer should be senior to the Commanders of groups.

I may add that, though it will be observed that this question of the system of command has been examined with reference to a fortress of large size, it will also be evident that, with certain modifications, it will be suited to even the smallest combination of coast defences. For example, where the number of forts or batteries is limited, and the various works are at but a little distance from each other, the Commander of the fortress may be able to take upon himself the duties of the Commanders of defences in addition to his own; in a similar manner, where there is but one section, its Commander may be called upon to discharge also the duties of a Commander of coast defences.

V. Arrangements for Intercommunication and for the Transmission of Orders.

An even casual consideration of the preceding portion of this paper will show us that an adequate provision of means of intercommunication between the several grades in the sequence of command is absolutely necessary to permit of the working of any systematically combined plan of defence. Too much stress cannot be laid on this point, since without such provision of a sufficient kind, many opportunities must be lost and much disadvantage suffered, for if we have it not, the chain of command is broken, reciprocal action becomes hopeless, and the concentration of fire impossible.

Those who have not carefully considered the conditions which govern the working of coast defence are inclined to undervalue the importance of this question, since, remembering only the size of the target offered by a battleship, they forget or do not regard her power of rapid movement. Officers, even of the Artillery, are inclined as a rule to imagine that the service of coast batteries is a duty which may be deliberately carried out, and are tempted to believe that, as the guns are heavy, so the work must be slow. It is true that in cases where the nature of the channels or of the coast line compels the attacking ships to anchor in order to obtain full effect from their fire, this may be in some degree the fact; but under circumstances which permit them to take advantage of even a moderate rate of speed, the movement of the target is far quicker, and the opportunity for efficient fire far more fleeting, than is the case with the targets offered to artillery in the field.

No force in the field, not even galloping cavalry, can equal, except perhaps for a few minutes, the speed of a ship which steams at the low rate of 12 knots per hour, a pace which may, under ordinary circumstances, be maintained during the entire progress of an attack. The guns and mines of a system of defence must therefore be prepared to cope with an enemy gifted with the power of exceptionally rapid movement, and their conduct in action must be proportionately accelerated and simplified. This acceleration, if it is to be combined with a facility for ensuring co-operation in action, can be obtained only by means of a complete system of rapid intercommunication between the various fractions of the defence.

If we consider next the character which such a system of communication should present, it will be evident that oral signals, whether by speaking-tubes or the telephone, will be useless in the noise of action, while visual signalling, by means of flags, semaphores, or cones, is not only slow and liable to error, but suffers moreover from great disadvantages, viz.:—

i. It is possible that the signals may be read by the enemy, especially since the code must be made out beforehand, and the enemy may thus have an opportunity to gain possession of the key.

ii. The flags, &c., point out to the enemy the position of the spot from which orders are emanating, and thus enable him to bring fire to bear upon the local centre of defence.

iii. Such signals would be invisible at night or in a fog.

If we abandon all such systems as useless, we shall find ourselves limited to electric (or perhaps pneumatic) communication, such as shall record the orders given on a dial or similar contrivance at the receiving station. The provision of such a system would certainly be expensive, but, since the value of artillery fire, in coast defence as well as in the field, depends entirely upon its concentration, it is probably no exaggeration to say that more advantage would be gained by the creation of such a network of communications between important points, than by increasing the weight or the number of the guns.

It is especially necessary to provide some such system of communication between the Commanders of units and the group Commanders of artillery, since when in action the former must transmit orders to the latter at least once per minute, in cases where the guns are (as they should and probably must be) directed from a station beyond the limits of the fort. Under such conditions electric communication is indispensable, as it is also between the unit and section Commanders, while the further provision of lines to the Commander of coast defences, and from him to the commander of the fortress, would be a small and simple matter. These last lines might be improvised in anticipation of an attack, and might even without any very serious disadvantage be dispensed with, for the general tactical plan of the defence will seldom be liable to any very sudden change of conditions or to any consequent instantaneous alteration, since the tactical considerations are more or less permanently fixed by the character of the site.

But with respect to the forts, it is absolutely essential (under penalty of an enormous loss of efficiency) that immediate communication shall be possible between the groups and the unit Commanders, who are in truth the eyes of the guns. I must, however, ask you to accept this as a fact on my word alone, as I have neither time nor opportunity at this moment to enter on the question of the conduct of coast artillery in action. I venture nevertheless to assert that all Officers who have studied the working of heavy guns in forts and batteries will support my opinion in the following two points, viz. :—

- i. That to ensure the co-operation (and therefore the full efficiency by concentration of fire) of all guns in a fort or battery, they must be directed by one head from a station outside the work.
- ii. That, to render this possible, some system of rapid communication between that station and the groups of guns is absolutely necessary.

I have endeavoured to bring before you in this paper a coherent system of command applicable to a coast fortress, to show the duties of the various grades of Officers included in it, and further to impress upon you the urgent necessity for the provision of a complete network of intercommunications within the fortress; but I am not, I regret to say, able to mention at any length other points of almost equal importance, such as—

- i. That all Officers and men, especially of the auxiliary artillery, should be drilled and worked in the actual forts which they will have to defend in action.
- ii. That all Officers of artillery should be trained in the duties of group Commanders, while all field Officers should be competent to act as Commanders of units.
- iii. That the entire scheme of defence for every fortress should be drawn out on paper in time of peace, and that this scheme should include all matters connected with the distribution of supplies, hospital accommodation, and the renewal of ammunition.
- iv. That all Officers who, by this scheme, will be called upon to discharge the duties of one or other of the grades should be confidentially warned of the fact during peace, and should be expected to qualify themselves for those duties.
- v. That every fort in each fortress should be occupied by regular artillery during some portion of each year, during which time practice should be carried on (under Service conditions, and not by the fire of individual guns), and all defects should be noted and made good.
- vi. That the mobilization of the garrison in each fortress should be carried out at least once a year by day and night.

I will ask to be permitted to draw a conclusion from this paper, viz., that this matter of coast defence is not a purely artillery or engineer question, but equally concerns Officers of infantry. I do not mean by this that we have any right to expect Officers of infantry to study details connected with gun drill or the construction of submarine mines; but I do mean, and in this I venture to think I am right, that Officers of infantry should be accustomed to realize that, when defending a coast fortress, they may be called upon to take a very prominent part in the struggle, and that therefore the principles of coast defence are not unworthy of their attention.

Colonel OWEN, R.A. : A friend of mine who is not in the army asked me just now whether the substance of the lecture we have just heard is not rather elementary. I was compelled to say that it was. A sad confession of the sin of omission in the past to be obliged to own that it is only now that this question of tactical organization of a fortress has really been thought out in a practical manner. We owe, I am sure, a great debt of gratitude to Colonel Walford for having performed this duty of drawing up a scheme for the proper tactical organization of coast fortresses. It is the first time it really has been dealt with in a definite manner. The time at one's disposal in these discussions is so short that although myself a Garrison Artillery Officer, I shall not enter into small technical details of the artillery portion proper, but I would make one or two general remarks as to the organization proposed by the lecturer with regard to the command. It seems to me that he has supplied rather a fifth wheel to the coach in introducing, under the Commander of a fortress, a Commander of coast defence and a Commander of the land defences. It seems to me, if you take any coast fortress, you, generally speaking, divide it into sections, each covering a part of the coast area of the fortress, more or less distinct of itself. Belonging to that sea area is a land area, and those two areas, partly coast and partly land, must be under the command of one Officer. He must command the whole definitely as Commander of such sub-section of the whole circuit of fortress. If you have many of such sub-sections, as you must have in many cases, and often at considerable distances from one another, I do not see how a Com-

mander of coast defence and a Commander of land defence would be required or utilized. It seems to me that the Commander of the fortress must necessarily communicate direct by means of his staff with the Commanders of sections or subsections, who, as the lecturer has shown, will, as a rule, have to carry out a preconcerted plan. The lecturer points out the paramount importance of communications between the units, that no combined effort could be made against an enemy if each Commander of a unit in a section of the defence worked simply on his own account, that these units therefore must be bound together in some manner so that they can be worked by one common head. We all must agree with every word he has said with reference to this point. But he goes on to mention that communications, he thinks, should be only electrical, and that they should be by means of a dial, or something of that sort, showing the message which is transmitted. That undoubtedly is quite right when you come to mere messages with regard to technical points, as the ranges of guns, elevations, and bearings, but you must have more than that. I am quite convinced that electrical communication must embrace either telephonic or telegraphic communication between the different units and the sectional Commanders, between the sectional headquarters and the Commander of the fortress. The Commander must be able to talk with those under him, and to explain his orders to them when necessary. You cannot send merely cut and dried short messages in all cases if you want the work satisfactorily done. That is my own experience. I have charge of a School of Instruction for coast defence at the Isle of Wight, and last year we did some very interesting work. We had several batteries in action at the same time, under service conditions, both by day and by night. We communicated with the greatest ease by telephone from the headquarters, miles away from some of the forts, to each unit. It appears to me you must have, in addition to a mechanical arrangement between the portions of each unit, another and more perfect means of communication between the units themselves (the forts or batteries) and the Officer commanding the artillery of defence, and between the section Commanders and the Commander of the fortress. For that purpose I am convinced that you must have complete telegraphic or telephonic communication, and that you should always have an alternative method of visual signalling in case your electrical communication should break down. There is another point which the lecturer has brought before you in which garrison artillerymen must also most heartily agree, and that is that any Officer, to whatever branch of the Service he may belong, is capable of commanding a coast fortress. There is no peculiar fetish about garrison artillery. We of the Garrison Artillery long that the other branches should know more of us, that we should be more directly under the General Officers commanding, whether they be infantry, cavalry, or artillery, that they should take as much interest in our affairs, and know as much about how we are progressing, and how our heavy gun-fire is carried out, as they do in regard to the musketry fire of infantry and the fire of field guns. When that day has arrived, and I hope it will be soon, it is certain that our progress will be more rapid than it has been hitherto. I am convinced that if infantry Officers saw more of the working of coast artillery, as it is now carried out in our coast fortresses, they would be far more interested in it, and we should then be more capable of carrying out the German system, which so carefully lays down, with respect to the annual manning of their coast fortresses, the absolute necessity of showing each arm of the Service employed in such manning, how they must mutually support one another and work together if those fortresses are to be properly fought against an enemy's attack.

Colonel F. T. LLOYD, R.A.: When it was announced that Colonel Walford was going to speak in this lecture room on the subject of tactics of coast defence, I must say I hoped that we should hear a little more about *fighting*. The lecture was a most interesting one, as bearing upon the organization of coast defence, but I am, I fear, a little old-fashioned, and do not quite agree with the modern school who talk about the tactics of garrison artillery. I have always understood that tactics was a science connected with the approach of two moving forces, or I should rather say of two mobile forces. In this case the only forces that move are ships; the guns are fixed, there is no movement about them. Therefore, how we can speak about the tactics of garrison artillery, I cannot really quite understand. Perhaps Colonel Walford will enlighten us further on that point. The lecture, as Colonel Owen

said, is on an elementary subject, and appears to be a very thoughtful enlargement of a series of instructions on coast defence organization, which came out some two or three years ago, and was then issued as a confidential paper to General Officers commanding districts. I think in all probability everybody in this room is acquainted with that paper. It was a most wonderfully able and well-arranged series of instructions to General Officers commanding, for the defence of their districts. As the result of those instructions, I believe I am right in saying that in every district in the Empire schemes of defence were constructed and arranged by Officers commanding and Officers in charge of departments in our coast fortresses, and these were eventually welded into a homogeneous whole by the General Officer commanding the district, who has had his own scheme, which remained at the headquarters of the district. These schemes—the individual schemes and the general schemes—were supposed to be passed on from one Officer to his successor, and I believe that is still done. The great point about that wonderful State paper—for it really was a State paper, and a most masterly State paper—was the fact that in the schemes of defence which were then ordered to be prepared, the text was, "Organize that which you have; do not attempt to organize that which you hope for; do not deal with what are called 'authorized armaments' which do not exist, or with men who are only on paper; but deal with your personnel and your matériel as they are." I think that was one of the chief points to be observed in those particular instructions. In Colonel Walford's paper he alludes among other things to high-angle fire. It is not necessary to remind the distinguished Officers whom I see around me that high-angle fire from our coast defences at the present moment does not exist in Great Britain. We have no guns mounted for high-angle fire. There are other points in which it seems to me the lecturer was running on a little ahead of his time. We hope to have these things some day or other, but we have not got them yet, any more than we have telegraphic communication between the sections. With respect to the Commanders of defences, I am very much inclined to agree with Colonel Owen, that they are certainly fifth wheels in the coach; additional channels through which orders have to be sent; and as orders in the presence of a moving fleet will have to be very rapidly communicated to group Officers, I think if we could manage to eliminate the Commanders of defences, it would be better. With respect to the Commanders of fortresses, I think that question has been raised in this Institution more than once before. It seems probable that he would be a specially appointed Officer, that he might be either a naval Officer or a military Officer: it matters not the least in the world. But I think the Commanders of sections, of units, and of groups *must* be artillery Officers. The battle is a battle of guns; all the adjuncts, such as torpedoes, mine-fields, electric lights, and so on, are merely adjuncts. The infantry in that case must be an adjunct. Therefore I think the commanders of sections, units, and groups must be artillery Officers. Of course, if the commander of a fortress happened to be a military Officer, he would naturally abstain from any interference with the senior naval Officer on the spot. The active defence is a thing entirely apart from the passive defence of the fortress; it is outside the limits of the fortress entirely. My view of the so-called active defence is a few ships cruising off the fortress, off the mouth of the harbour, or whatever it is; and they have really nothing whatever to do with the local defence of the place except to keep the local commanders informed of what is going on, and if possible engage the enemy before they come up to the neighbourhood of the fortress. I should like to say a word or two about the control of the electric light, which Colonel Walford passed over rather hurriedly. I know that time is very short, and the subject is so very large that it is almost impossible to get everything into an hour's lecture. The electric light is intended for several purposes: to show up large ships, so that they may become visible to the gunners; to illuminate fixed obstructions for the same purpose; to illuminate the mine-field so as to detect the approach of countermining launches, and so facilitate its defence; and lastly, to search for and light up any possible flotilla of boats attempting a night surprise. Electric lights should, therefore, always be held at the disposal and under the control of the commander of the section, or in some cases of the commander of the unit or fort. Colonel Walford did not touch upon a point of great difficulty, that is, the relation of the Officer in charge of the water defences in the neighbourhood

of forts to the section or the fort commander. The difficulty that I speak of arises from the want of adequate and rapid communication between the land and the sea forces. We have no organized system of communication existing at present; and if one could be devised it would facilitate the defence very much indeed. The commander of the fortress, I said just now, might be either a naval or a military man, but I think the commander of the section must be an artillery Officer. The commander of the section in peace-time is an artillery Officer; the details of the defence are almost entirely technical, and nearly all appertain to the artillery. When the time arrives for the guns to be silenced, I think we may say that it is "all up" with the defence. Colonel Walford speaks also of reliefs and reserves. Any engagements between ships and forts will probably be of very short duration, and moreover our present available strength is certainly not sufficient to provide for reserves, probably not for reliefs. Of course we should provide them if we could; but in every fortress in which I have served, if we count up the auxiliary forces that are allotted to it, as well as the actual forces which are already there in time of peace, we do not find, as a rule, that there are more than five available men to a gun. That is a very small allowance out of which to provide reliefs and reserves. Colonel Walford says, "In the absence of special instructions from the commander of the section, it is the duty of each unit to engage that ship of the enemy which is the nearest to it at the moment." But a little further on he says, "The commander of a unit has therefore no right to change his target without having received orders to do so;" and he gives his reasons. These two statements appear to conflict a little bit, and it is a point that ought to be settled authoritatively. It is a very important point indeed, and affects the whole train of command. My own impression is that the commander of the unit should have a little more power of initiative, and a little more responsibility than Colonel Walford would give him, and that the sectional commander whose station is at a considerable distance from some at least of his forts should abstain as far as possible from exercising a too rigid control. It would hardly ever come within his province to point out the exact target at which the unit commander should have his guns laid. The last, and one of the most important points in Colonel Walford's lecture refers to the communication of orders. That is really the *crux* of the whole matter. The telegraph, I believe, can alone be relied on. I do not agree with Colonel Owen that the telephone is of much use. He has had more practical experience of it than I have, but I have generally found that whenever the telephone is used, a non-commissioned officer or a private soldier is placed at each end of it, probably a non-commissioned officer, and there is a good deal of shouting and bellowing, "What is that? Say it over again," and so on; and when this is interpreted by the man at the other end, ten to one you get something wrong. I am sure the telegraph is the only thing to rely on, and that if there is any chance of the telegraphic communication being interrupted we must have duplicate lines. There was one particular point on which Colonel Walford did not touch, on which I hoped to hear him say something, and that was on the choice of the target. You know we only exist to shoot. Shooting is the main point, after all, and he did not touch, except very slightly, on that particular point. We should very much like some authoritative decision as to the choice of target in action. The old rule is that we are to fire away as hard as we can at the nearest ship, with due economy of ammunition, of course; but our fire is to be as rapid as possible at the nearest ship. It seems to me to be a very rough and ready sort of rule, and therefore we want something laid down about that. There are two objects for which a hostile fleet may approach a coast fortress. In one case they may be intending to run past it in order to gain some point beyond, and in the other case they will attempt to destroy the works and the guns in order to effect a landing. I think we may be pretty well satisfied that no ships will attempt to run past mine-fields as they exist at present. It was done, I believe, in the American War, and frequently without any great damage to the ships; but we are further advanced in submarine warfare than we were then, and I do not think that any commander of a ship would be now justified in running past an unexplored mine-field. Then, with reference to the naval attack of a fortress, our naval experts, so far as I can gather their opinion, believe that no modern fleet will care to engage a modern fortress properly armed and manned, unless they have command of the sea. That is a very important qualifica-

tion ; but it does seem probable that unless they have command of the sea they will not care to run the risks of being found with their magazines empty. Remember that they cannot get supplied with ammunition as the shore batteries can, and they would hesitate very much before they run the risk of engaging our coast fortresses. Naval Officers tell me that the fire from ships moving at a high rate of speed is not always very effective, and I think from my own experience, and from what I have seen of ships in a seaway firing at targets steaming round them, their fire is not to be depended upon for very great accuracy, and that if they want to effect the reduction of modern works they will either have to anchor, or proceed at a very low rate of speed. I say this under correction, because I have very little experience of it myself ; but I understand that is pretty much the case. I think Colonel Walford's final remarks were excellent, and very much to the point, but after all, if we come to sum up the whole matter, what is most required in the present day is a better system of communication of orders, and a greater rapidity of fire, irrespective of the contents of our magazines. Engagements would be so short that we could hardly fire too fast. I am quite certain that economy of ammunition must be a thing that is not to be thought about in the defence of our coast fortresses. We have 100 rounds a gun. It takes a very long time to expend 100 rounds from very heavy guns, therefore economy of ammunition is not to be thought of. You must fire away as fast as you can with accuracy, but above all we must trust that the authorities will in the near future do something in the way of giving us better communication between the units which compose coast fortresses. Unless the comparatively trifling expense of this and other adjuncts be faced, control of fire is impossible, and organization nothing but a name.

Captain F. S. JACKSON, R.N. : I think it is rather a pity that you, Sir, had not an opportunity of speaking on this paper at an earlier period than you will have as Chairman, as it is rather in your way. The last speaker referred to the want of fighting in Colonel Walford's paper. I should think it is extremely probable that there would be, because in all probability there will be an absolute want of enemy. I had not the advantage of being present at the former lecture, so that I am not quite sure what his "fortress" is, but if it is to be defined as one may suppose it to be from the numerous units which form the defence, it is something very big. It is not a mere coast battery, it is not a small thing, it is a large series of works for the protection of a harbour or channel. I go a great deal further than Colonel Lloyd ; I go a great deal further than saying that no naval Power is likely to attack a fortress of that description unless they have the command of the sea. I say they will not think of attacking a fortress unless they not only have the command of the sea, but they have such an absolute superiority, and such a number of ships, that they can afford to run the risk of the loss of or serious damage to a fleet, and then retain the command of the sea, which is a very different matter. However, I must say this, that the organization which I have no doubt, so far as I know, has been most accurately worked out, seems to me rather worked out for the purpose of fighting phantoms. But there are one or two things connected with the organization which after all are, perhaps, the only part of the paper which we have a right to criticize, which I wish to call attention to, and one is the active defence, consisting of such ships, torpedo-boats, &c., of the Royal Navy, as might be detailed to the particular harbour in question. Now, it cannot be too often said, and it ought to be thoroughly understood by those who are ever likely to have command of defences, that it is the distinct policy of the Admiralty, announced over and over again, which they show no symptoms of changing, that under no circumstances whatever will they ever detail any ships or torpedo-boats of the Royal Navy for any particular harbour. They might by chance be there at the moment of attack, but it is most improbable that they would be detailed for the defence of the place. And again, with regard to the submarine mine. Submarine mines are to be laid down, according to Colonel Walford's organization, on the decision of the Officer commanding the coast defence, not even of the Officer commanding the fortress. Now, submarine mines are a species of defence which are especially those of a weaker maritime Power against a stronger. It may be necessary for the purpose of defending certain harbours and channels that we have them in our possession, and are prepared to lay them down at short notice, but as part of the defence of an English fortress, a sub-

marine mine ought to be a thing very charily used.¹ As a rule our interests are to keep open every channel till the last possible moment. Undoubtedly the Confederates did great things in the Civil War of the United States with submarine mines, but then they were prepared—except at certain places where they wished to admit blockade runners, and which were not so strongly blockaded by the United States ships as to prevent such entry—they were prepared to absolutely block the channel; and until we have ceased to be a maritime nation, I think that is excessively unlikely to occur. There is really very little from a naval point of view to be said about the organization of this paper. From my own knowledge I can cordially agree with a great many of Colonel Walford's recommendations, but I am afraid if I were to say anything about them, I should, perhaps, do something to deserve the taunt which has been so often applied to me, that I am more a soldier than a sailor.

Colonel CARDEW: It is with great diffidence I rise on this occasion, being an infantry Officer, but the paper is interesting to me from the fact that I have had the privilege of commanding a coaling station, and, therefore, there are one or two points I should like to call attention to in it. With regard to the suggestion that there should be "commanders of defences," I agree with Colonel Owen in thinking that they are like the fifth wheel to the coach, but I am of opinion that the commander of the water defences should be independent of the "commanders of sections," and that he should be directly responsible to the commander of the fortress. The water defences can be conducted in a measure independent of the land defence, though the two may co-operate on occasion during certain phases of the defence. I assume that in the water defences would be included, for instance, the service of the patrol boats; the mine-fields and their preparation; the flotilla of guard boats; torpedo batteries, locomotive and stationary; quick-firing and other guns for flank defence of mines; fixed and search lights, &c. It seems to me the commander of the water defence should have all their various adjuncts under his control. And there is one thing, I think, which is essential, and that is that he should be a naval Officer. Mining and torpedo operations for defence of fortresses are at present in the hands of the Royal Engineers, but as the naval forces are also fully conversant with this nature of operations, and as, moreover, water is the element on which they fight, it would only seem consistent and logical if a naval Officer commanded the water defences. With regard to the personnel of the water defences, for the same reason, they also should consist of naval and *sea-faring* men as a whole. Turning to the coast as distinguished from the water defences, the artillery in most nations in Europe consists not of garrison or land artillery but of marine artillery. We use garrison artillery, and I think it would be advantageous if marine artillery could be substituted, the latter, associated as they are with the Navy, must be more conversant with the nature of ships, their armament, the weight of metal they carry, their thickness of armour, &c. I do not suppose Royal Artillery Officers are much acquainted with war ships, though undoubtedly there are some who have made the subject a special study. I cannot agree with Colonel Lloyd in his contention that the sections should be entirely under the command of artillery Officers. There is such a thing as infantry, and this arm plays an important part in the defence of works. Besides, as Colonel Walford pointed out, it is not necessary for the commander of a force to have technical knowledge of the details of the several arms which he has to command. I would even go so far as to say I do not think it would be quite out of the way if a naval Officer commanded the whole of the garrison of the fortress, in fact, if he were *the commander of the fortress*. We are exceptional in having military Officers in command of coast defences. Of course it would be presumption on my part to dogmatize on such a subject as this, but I would instance what other nations do in the matter, and also quote what a very eminent Officer, who was in this theatre a few days ago, I mean General Sir William Jervois, said, which was in effect that he hoped to see the day when coast defence fortresses and coaling stations would be commanded by naval

¹ At a home port submarine mines should not be placed in position without orders from the War Office.

Officers. In Germany they lay down the axiom that not only the entire defence of the forts but also of the littoral should be in the hands of the Navy. In France the Navy directs the defence of the maritime fortresses, of the five naval ports, looking after the armament or the coast batteries, and submarine defences. The local defence of the commercial ports is in the hands of the Army, which also furnishes the men required for the land forts of the naval ports. In Italy the local sea defence is in the hands of the Naval Department. In Austria the system of defence is a mixed one, the coast defences are under the War Administration, of which the Navy forms a section; the naval fortress of Pola is under the command of a Vice-Admiral, the Navy provides to some extent for the manning of the batteries and sea forts at Pola, and entirely for its submarine mining defences. In Spain, Russia, Sweden, and Norway the coast defences are all under the charge of the Navy. In the United States the system of defence of the maritime fortresses is similar to ours, but that I understand is now under consideration.¹ I have myself experienced the difficulty of not having naval Officers for the command of the water defences. At a certain coaling station I was at, the Defence Committee had that masterly paper, which Colonel Lloyd alludes to, as their guide for the purpose of drawing up a scheme of defence, but the difficulty was to know who to place in command of or to work the necessary flotilla of boats, steam launches, &c. The senior naval Officer on the station said he could spare no Officers or men for the purpose, as he required all he had for the defence of his ships, and obviously there were no Officers or men of the land forces who were professionally capable of doing it. So all that the Committee could trust to was the hope that at some future time some Officer might be available for command who had some seafaring experience. Now it appears to me that a naval Officer is most fitted for the command and organization of water defences, he possesses the knowledge of submarine warfare, and must know better than landmen how to adapt steam launches and other things for the purposes for which they are required. With regard to communications, it is very desirable that they should be either telegraphic or telephonic, the latter for preference, if the difficulty about the noise of firing interfering with the delivery of the message can be overcome, for its use has the advantage of not requiring specially trained men. The serious objection to visual signalling, besides the one that it is liable to interruption under certain conditions of atmosphere, and on occasions of smoke, is, that it requires so many men, which is a serious consideration with the very attenuated garrisons we have for our coaling stations. I can bear out what Colonel Lloyd has said with regard to the paucity of gunners; instead of having three reliefs per gun, we have hardly one full detachment at some of our fortresses.

Colonel E. THACKERAY: In his very able paper Colonel Walford mentions having purposely omitted to discuss the action of land forces against a coast fortress, confining his remarks to the consideration of the action of a naval assault. But I would ask, with all due deference, why these two methods of attack should not be considered simultaneously. The usual instances of attacks which were referred to in the last discussion, I think by Colonel Tulloch and the late Colonel Tovey, and also many historical cases, all seem to show that an action might take the form of a combined attack by land and sea. The remarks made by Colonel Tovey, whose death we have greatly to deplore, were very applicable to this point. He mentioned that in defending a harbour it would be possible to concentrate your strength on the direct channel of approach, to multiply your batteries, and to spread your guns, and that if an enemy had to attack such a harbour they would not be likely to run their heads against strong defences if they could possibly avoid it; but if they could land a force along the coast that would outflank the defences by an attack in rear, they certainly would do so. By the construction of a circular railway it would be possible to move guns as well as ammunition to batteries so placed as to reply to the attacks of the ships, and also the batteries on the opposite side of the fortress. A description of a circular railway of this kind was I think given in one

¹ The above information is taken from an occasional paper on "Coast Defence Systems" in vol. xxxii, No. 146, of the R.U.S.I. Journal.

of the Royal Engineer's Professional Papers in 1887 by Captain Louis Jackson, on "Entrenched Camps and Detached Forts." It recommended the placing of guns on travelling carriages to be easily moved from one position to another. At the commencement of a day's firing the battery would take a position on a set of platforms. If possible they would remain there all day, but if the fire became too hot they would remove to another position. This has reference to considering the defence for the land side simultaneously, and in connection with resisting attacks from ships. I have only ventured to offer these few remarks hoping, perhaps, that Colonel Walford will supplement his valuable lecture by considering the attacks from the land side, and the organization necessary to resist them at the same time as those from the sea. With regard to the commands, the command may be held by a naval Officer or by a military Officer, an Officer of infantry, an Officer of cavalry, of artillery, or of engineers. The chief desideratum would seem to be that, whatever Officer is appointed to the command he should be possessed of complete knowledge and information as to the best method of resisting either or both forms of attack.

Colonel OWEN: As already mentioned I am quite sure that infantry Officers, and those of other arms, would take much more interest in the rôle of Garrison Artillery, and be enabled to work with them better in the defence of coast fortresses, if they saw a little more of their work. I can only say if any Officers of other arms would pay us a visit at our camp of coast defence instruction at the Western Forts, Isle of Wight, I think they would derive as much pleasure from their visit as it would give us, and the Headquarters authorities would, I am quite certain, willingly give them the necessary permission and facilities, as in the similar cases of the Mounted Artillery Camp at Okehampton, and that for Siege Artillery at Lydd.

The CHAIRMAN (Admiral Colomb): In concluding the discussion, and asking you to offer your thanks to the lecturer for his very able and clearly drawn paper, it is usual for the Chairman to make some observations. My own view on a paper of this kind is pretty well known, that is to say, I think the lecturer would have been better employed in treating the attack of fortresses rather than the defence of fortresses, for, as Captain Jackson has put it, what he has to think about is whether he would ever get an enemy approaching an English fortress. Of course, I do not mean to say that the thing is not possible, but we must be in a very bad way when we have to put into force the substance of this paper in the defence of our fortresses. Possibly we should be more likely to want the organization here displayed in the case of some of the outlying smaller coaling stations or isolated points upon which the enemy could make an impression with a very small force. But, as Captain Jackson said, this paper refers not to that, but to the defence of large organized fortresses such, I presume, as Portsmouth and Plymouth. Colonel Owen expressed the opinion that only now was it that a paper of this kind had been read, that is to say, that such a paper had been a long time wanted. Now, I think the reason why such papers have not been read really is, that they are not a part of our business, that the necessities of these arrangements are so remote that really the instinct of naval and military Officers has been against preparing such papers. There is, I think, one cardinal error, if I may so say, running through the paper put before us, and that is that the naval attack, the attack by ships, will ever be the principal attack upon a fortress. I observed with very great surprise that Lord Wolseley, in a paper in the "North American Review," I think, of December, had fallen into the error of supposing that in the discussions which went on in this theatre last year, naval Officers were all along advocating the attack of forts by ships. I think Captain Jackson, as I understood him, agrees with me, and, as far as I know, the opinion of the Navy is pretty clear, that for anything but a passing bombardment we never should dream, and no nation would ever dream of making an attack on a fortress by ships alone. The experience of the Federals and Confederates in the Civil War seemed to be clear on that point; and curiously enough Lord Wolseley brings forward the case of Charleston, as proving that naval Officers are wrong. Naval Officers have, however, used that very case to point out the impracticability of modern ships making real impression upon a fortress unless supported by land forces. And, therefore, I cannot help thinking, with Colonel Thackeray, that if we were to have a paper on the defence of sea fortresses we should have had it, as they

certainly will be attacked. The chief attack, so far as the Navy knows, so far as naval Officers all over the world know, must be a land and not a sea attack; and I think it has become more certain that that would be so since the introduction of submarine mines. A submarine mine is such a disturbing element that ships proper will give them a very wide berth. It must be for some very great advantage, indeed, that ships will run the risk of getting amongst a mine-field; and so far from the tendency of the age being to bring ships into actual contact with forts, as they have been in times past, it seems to me that the tendency is precisely the opposite way, that there will be less of the attack of ships proper on forts. The only way in which I think forts will be attacked by ships would be as Fort Fisher was attacked, that is to say, by ships built on purpose. But the ordinary battle ships will, as a rule, keep out of the way of forts altogether. The active defence which has been spoken of, as far as I know, is non-existent. The enemy may possibly attempt to make a sortie now and then, but, as a rule, as it has been in the past, and it seems to be more likely to be so in the future, the ships would be laid up and the men from the ships passed into the garrison. Colonel Lloyd spoke of the fire at high speed. I might venture to say that our opinions in the Navy are rather altering about that: the improvement in the mounting of guns, and curiously enough the improvement in the mounting of the very heavy guns, the 67- and 42-ton guns, is so great that the accuracy of their fire when passing at high speed has distinctly increased. It is a remarkable feature, I do not know quite whether it is fully made out yet; but certainly in some figures that have been recently furnished to me by a friend, it does look as if the accuracy of naval firing passing at high speed had increased considerably. There is one form of attack, therefore, I think, which is more perhaps in the nature of a punishment than an actual attack. I think it remains possible that ships may run past forts at some speed for the purpose of doing them damage, in the same way as the works of Odessa and the works of Alexandria were bombarded, which are more in the nature of reprisals and damage, and are not real attacks upon the fortress. Colonel Cardew spoke of the advantage of having naval Officers in command of a fortress. I think he is quite right in the instance he brought forward. Russia, Germany, France, and Italy to a great extent, and Austria to a great extent, do put the coast fortresses into the hands of naval Officers; but the tradition of the English Navy is in some way or other against that; the tradition is very strong that the naval Officer ought to be at sea. I do not know how the thing may ultimately lie, but certainly the naval Officers, as they go at present, are not ambitious of taking the command of fortresses. From my own personal point of view, I think that something in that way would be advantageous both for the Army and the Navy. Colonel Cardew also spoke of a very important matter, the general extreme shortness of our garrisons. We seem to be inclined to build fortresses all over the world, and to think that when we have got the forts, and especially when we have got the guns, that nothing else is required. But to my mind, we want, if anything, more garrisons, and less guns and forts. That is the way one looks at it. As to the communication, and generally as to the paper, of course, I think we must all agree that if you have fortresses small or large, if you have stations where there are detached batteries arranged, they must be under a single command, and that command must be brought about by some instantaneous means of communication. You should not fear the expense of the electric telegraph, or whatever means of communication may be best, to bring up each detached fort under the immediate thumb, so to speak, of the commander of the fortress. I think, myself, the lecturer is right in saying that the electric telegraph is the best method. One speaker talked of there being no means of communication between our ships and the military, but I think there is. The naval signalmen are taught to use the Morse alphabet with the flashing system, and to work it with the army, and I think communications ought to be quite easily kept up in that way. I will not detain you with any further remarks, but in asking you to thank Colonel Walford for his excellent paper, I will at the same time request him to reply to the observations that have been made.

Colonel WALFORD: The first point that strikes me is that I have got material for at least one more lecture, if not two, in the criticisms which have been made on my paper. It has been said that the lecture is elementary. It was intentionally so. I

was quite unaware of the circular of which Colonel Lloyd spoke, and being certainly under the impression that nothing of the kind had been done, believed that it ought to be done. With a desire to bring the matter forward for discussion, I was anxious to present my view of the principles of coast defence. Being, however, limited with regard to time, I thought it impossible to attempt to enter in any way into detail, and therefore merely endeavoured to lay down and to get accepted a certain number of elementary principles from which we might further reason, and proceed into detail. Colonel Owen spoke of the commander of the coast defences as a fifth wheel to the coach. But he appears to work on the principle that the sectional commander should command a portion not only of the coast defences, but also of the land; this, I think, would be radically wrong. The coast defences are perfectly distinct from the land defences as regards the actual character of the fortifications, the nature of the armament, and the course of the necessary training, as distinct as the difference between the service of coast guns and the service of siege guns can make them. With regard to defence of fortresses, I quite agree that the defences of the land front are as important as, perhaps even more important than, the defences of the coast front, but I hold that it is a totally distinct and separate chapter of the subject. With reference to the telegraphic communication, I did not wish to lay down that dials only were necessary. Any form of telegraphic communication would be most useful, and anything we could get I am sure we should only be too happy to accept. With respect to visual signalling, particularly the use of the dial at the posts occupied by Officers commanding units, I must confess it seems to me to be a very great source of danger. You distinctly point out to your enemy by means of the very instrument you use for signalling, where the centre and eye of the defence of the unit is, and probably, if he knows his work, you will find that eye put out. Colonel Lloyd objected that there was not enough fighting in the paper. I am very sorry not to be able to humour him, but I think that his complaint is due to the fact that he has not read my former paper. I do not speak of that as a crime; perhaps we may call it an omission. He will find that I there mentioned, in addition to some fighting, the electric light, and also the difficulty of working the water defences with the armament for the defence of mine-fields, and further, gave my reasons for supposing that the word "tactics" need not of necessity imply movement. In order to save time, therefore, I will not enter into those matters again. Colonel Lloyd also said it would have been better, perhaps, if I had spoken only of what we have got. If I had done so, I should have been compelled to make some mention of what we have not got; this would not, I think, be desirable, and I therefore preferred to take a purely apocryphal and imaginary case. In taking that case I chose the largest size of fortress that could be imagined, but had no particular fortress in my view. It appeared to me that if I described the largest organization of the kind it would be perfectly simple to reduce that organization to suit the smaller units. Colonel Lloyd further points out that in my paper I suggest "That it be accepted that in the absence of special instructions from the commander of the section, it is the duty of each unit to engage that ship of the enemy which is nearest to it at the moment," and that a little further on I say, "the commander of a unit is not to change his target without having received orders to do so." What I intended to express was this, that supposing the attention of the commander of a section to have been devoted to some other particular portion of the section, and no orders as to the target to have been given, the Officer commanding a unit might find himself, in the absence of instructions, unable to decide as to which target to fire at, and in that case I think it might be established as a fixed rule that he should fire at that which was nearest to him; but that where he had received orders to fire at a certain target, he had no right to leave that target without orders to do so. Colonel Lloyd next proposed that the section commander should not point out the target. I must confess I cannot at all agree with that proposition. It seems to me to strike at the root of any power of concentration of fire. I cannot imagine, given every possible convenience of communication for the working of guns, any possibility of concentration of fire, unless the section commander is not only allowed to point out the target, but is laid down distinctly to be the only person who should point out the target. Colonel Cardew proposed to separate mines from guns. That I have not attempted to enter upon in this paper. I think most artillery Officers

are very strongly opposed to such action. To my mind mines and guns must work together: they are two arms as closely bound together as infantry and cavalry. Captain Jackson has taken a line which I expected Admiral Colomb to take: that great preparation for the defence of coast fortresses is not absolutely necessary, on the ground that it is improbable that those coast fortresses would be attacked. But coast fortresses do exist, and as long as they exist and are garrisoned and armed, it is necessary that we should work in some degree towards attaining an organization for them, unless, indeed, it is presumed that an organization improvised at the moment of attack would be sufficient, as to which I myself have my doubts, especially as regards the matter of supply. I think, also, that an organization which is formed on the moment at a time of emergency is very likely to be geared so roughly that it would not work without extreme friction. If it is worth while to build fortresses,—which may be a moot point, and to arm them, which may also be open to argument,—then it is surely worth while to have some distinct system under which the garrison shall be commanded and directed in action. Admiral Colomb spoke with regard to what I have said of the active defence, and he considers the active defence would, as a rule, be non-existent, ships in the port or harbour being laid up in case of an attack on a coast fortress. I am not prepared to give an opinion upon this point, but I was led into making use of the words “active defence” by the fact that I have always understood that included in our Navy there are certain ships which are not looked upon as sea-going ships, but are intended for the defence of harbours. I presumed those ships would be used for that purpose in time of war, and would not be laid up. I am very sorry if I have not replied to every criticism, but I have such a long list of references, that I may very possibly have omitted some.

The CHAIRMAN: We understand that Colonel Walford has more matter behind, and I hope that after Easter we may hear something more from him upon this subject.

Friday, January 31, 1890.

ADMIRAL H. BOYS, Vice-Chairman of the Council, in the Chair.

MODERN GUNPOWDER AS A PROPELLANT.

By Major F. W. J. BARKER, R.A.

1. Introduction.
2. Distinction between "explosive" and "propellant" as demonstrated by the different action of "old" and "modern" powders on gun and projectile.
3. Ingredients and outline of processes of manufacture.
4. Progressive steps from the old explosive to the new propellant.
5. Powders for the new small-arm magazine rifle.
6. Smokeless powders.
7. Conditions under which gunpowder is now admitted into the Service, and precautions to be observed in keeping it.
8. Practical results.

1. In my lecture to-day, I may possibly have the honour of addressing representatives of three classes of gentlemen who have much to do with explosives and propellants—

1. Those who invent them.
2. Those who manufacture them.
3. Those who use them.

The first two classes are doubtless, and fortunately for us all, in the minority, and I must ask them kindly to accept my apologies, when I address the remarks to be made this evening almost exclusively to those who are the users of gunpowders now in the Services.

It is, perhaps, desirable, at the beginning of this lecture, to consider for a moment the meaning of the term "reliable propellant." I submit that it may be popularly and fairly defined for our purposes, as a trustworthy speed producer which is properly under control.

2. This being so, I invite your attention to the table before you (Table E), showing the gunpowders used in the Services; and we shall presently distinguish between the characteristics of the old and well-known explosive, and modern gunpowders as propellants.

We hear a great deal in the present day about the power of modern guns, the energy they develop, their accuracy, and the armour-piercing capabilities of their projectiles.

Not so much, however, is heard of the propelling agent, or the speed or velocity of the shot, upon which efficiency and power depend, and without which, the most powerful projectile ever designed would only be an inert mass of metal.

I, therefore, propose to consider the claims of modern gunpowder to the title of "reliable propellant," and from this point of view to examine its characteristics as a speed producer.

Let us now see what speeds or velocities can be obtained, and by comparing the rate per hour which we are accustomed to consider high, where steam is the propelling agent and a railway train is moving rapidly, with that attained by nearly a ton weight of metal contained in the modern projectile, we may grasp more fully the difficulties to be overcome by modern guns and modern gunpowders.

We are all tolerably well acquainted with the results which have been accomplished by steam, and yet, when we stand on a railway platform and see an express train rush by at a speed approaching 60 miles an hour, it is difficult to avoid a feeling of amazement at the rapidity with which it passes and the propelling power which drives it.

Keeping this example of speed in view, we can better realize the significance of those velocities on the diagram before you, which represent speeds of over 1,365 miles an hour.

Or, if we compare these results in other words, we find that, before an express train going at full speed from London could reach Portsmouth, a shot, travelling at the ordinary rates of modern projectiles, would pass Gibraltar.

Again, the working pressures of steam range, as a rule, between 30 and 250 lb. on the square inch, according to the nature of the engine employed, while the working pressures of gunpowder are from about 35,000 to 40,000 lb.

The necessity for these comparatively high pressures with gunpowders is due to the fact that the great speed must be obtained in the very short space available in the serviceable length of a gun.

As we are discussing a substance which is generally termed an explosive, it may be well at this point to invite attention to the distinction between "explosive" and "propellant," as demonstrated by the different actions of old and modern powders on the gun and the projectile. The diagram before you (see Plate I, Fig 2) illustrates in a simple manner what I wish to convey.

We have here represented in dotted lines, three guns, each of which is acted on by a different agent.

First. A "high explosive" guncotton, or nitro-glycerin, is used. This destroys the gun, while it hardly imparts any velocity to the projectile.

The enormous pressure developed, probably over 150 tons per square inch, is (as sketched in the pressure curve) too instantaneous for the structure of the gun to resist, or for the development of the velocity of the shot.

With the second gun Rifle Large Grain is used, and this also gives a tremendous strain or sudden shock to the gun, while imparting a low velocity to the projectile.

The third gun is fired with modern brown prism¹ powder, and you

¹ S.B.C., slow-burning cocoa.

see a very moderate pressure gradually developed, and a high speed given to the projectile.

3. We shall now consider the nature of the substance which makes results such as have been already mentioned possible; and briefly describe the ingredients and processes of manufacture.

Old gunpowder used to be somewhat inaccurately described as a mechanical mixture, the components of which were saltpetre, sulphur, and charcoal—75 saltpetre, 10 sulphur, 15 charcoal.

No mention was made of the water which was always present in greater or less quantities, and hardly anything was known of the real composition of the ingredient called "charcoal."

The new powders, black and brown, are now recognized as a mechanical mixture of four chemical components, the only uncombined element, or simple substance, being sulphur.

The influence of the relation between the proportions of carbon, hydrogen, and oxygen in charcoal is now understood, and has recently been further worked out and developed by Colonel W. H. Noble, Royal Gunpowder Factory; and the action of the fourth ingredient, water, is carefully considered, both in its aspect as at first a retarding and shock-reducing agent; and, afterwards, as an aid in the form of steam (or the two gases H_2O) to the propelling power of the gunpowder.

If we look at the table of ingredients we see the differences clearly defined.

TABLE A.—Gunpowders.

Old. Black.		Modern. Brown.	
KNO ₃	75 saltpetre	79 saltpetre.	
S.....	10 sulphur	3 sulphur.	
C.....	15 charcoal { willow alder dogwood }	18 charcoal.. straw { carbon. hydrogen. oxygen.	
		1·7 } water { hydrogen. 2·2 } oxygen.	
<i>Black.</i>			
	75 saltpetre.		
	10 sulphur.		
	15 charcoal { carbon. hydrogen. oxygen.		
	1·0 } water { hydrogen. 1·3 } oxygen.		

Let us note the new features here.

Water is no longer looked upon as an unavoidable evil; and the steam, or gases produced from it hold a recognized position in the new propellant; while the charcoal has fixed proportions of carbon, oxygen, and hydrogen, which (when properly prepared) it should always contain.

Further, 1 lb. of water will produce 47,030 cubic inches of steam at a temperature of 212°.

Therefore a charge of 100 lb. of gunpowder with the average of 1.5 per cent. water will have 70,545 cubic inches of steam produced, in addition to the gases evolved by the other ingredients, and omitting any allowance for the tremendously high temperature of the ignited charge.

The two vessels of water before you contain the amount which should be present in 100 lb. of Service gunpowder. The larger quantity is 2.2 per cent., the maximum limit, and the smaller is 1 per cent., the minimum limit.

It is well to realize that the portion of the old maxim "keep your powder dry" must be considerably modified, and that though modern gunpowder is designed to stand the ordinary changes of climate, to which most of our war matériel is exposed, yet it may resent artificial roasting, or baking in magazines close to engine room or boilers, as treatment amounting to positive cruelty!

The question is one which, in all seriousness, must be carefully considered, and an inspection of the table before us shows how important it is.

TABLE B.—*Effect of Moisture.*

Percentage of moisture.	Maximum pressure in tons per square inch.	Muzzle velocity in feet per second.
1.5	17.76	1497
1.0	20.18	1523
0.7	22.02	1545

It is thus seen that as the water is decreased so the pressure and velocity are increased; and that the increase in pressure is very considerable when even a small quantity of water is taken away from the proper proportion.

Having briefly discussed the ingredients of modern gunpowder, it may be well to examine in outline the processes, in order to understand some of the steps which have converted an ungovernable explosive into a reliable propellant, capable of producing results as to speed and regularity which compare favourably with any other motive power under similar circumstances, and even with our old and well-known propellant steam.

For those who have not time at their disposal to burden their memories with details of manufacture, I have drawn a tree diagram, which indicates enough in a graphic form to show the development of gunpowder from the raw material to the finished product (Plate 3, Figs. 3 and 4).

The roots of the tree show the ingredients and their proportions, while the stem has printed on it the various operations of manufacture, the combined effect of which is to produce a reliable propellant, suit-

able, by slightly varying the details, for every modern weapon, from the pistol using 18 grains to the largest gun, which requires for each charge 960 lb. gunpowder.

As it is not proposed in this lecture to discuss the manufacture of gunpowder in detail, I shall only name the processes, each of which has a considerable influence on the characteristics of the powder produced.

They are exhibited, as you see, along the stem of the tree, and also on the diagram which is placed beside it.

The branches of the tree are arranged to show the natures of the guns with which the powders are used.

I may here point out that as almost absolute uniformity of character is a necessity, for each nature of powder, difficulties in manufacture are experienced, which few, who have not practically studied the subject, can realize.

For example, a day's production represents about a unit or lot of 100 barrels—10,000 lb.

This large quantity must be as nearly as possible absolutely uniform in itself. That is to say, every charge from it, which is fired from the same gun under similar circumstances, should give identical results as to speed and pressure.

This batch of powder is, however, made in many machines, on the out-turn of which, the weather and temperature exert considerable influence; and, besides this, the machines are tended and worked by different men, each of whom has what may be termed a personal error, which is enough in each process to make a considerable difference in the portions of the batch or lot, made by those working at the same time.

The consequence of this would be that, if unadjusted, the lot of 10,000 lb. as a whole would prove to be most irregular in its characteristics and unreliable in its shooting.

To overcome this, a constant systematic method of intermixing the various batches from each process is adopted; and this (which is termed blending), being carried out on scientific principles, gives a uniformity to each unit of 10,000 lb., which could not otherwise be obtained; and we are thus provided with reliable and uniform batches or lots of the propellant under discussion.

4. We are now in a position to consider how the new propellant has been developed from the old explosive, and the various steps which during the last few years have completely altered the character of gunpowder.

The story of the unsuitability of the early black powders to arms of precision is now an old one, and many of us remember the various methods proposed to obtain regularity, and to reduce the violence of gunpowder, when the requirements of modern guns were beginning to be understood and acknowledged.

The large charges of even the most suitable black powders, in the very heavy M.L. guns, were found to strain the inner steel tubes, and had a tendency to split them, and further efforts were necessary to control the violence of gunpowder.

The diagram of progressive steps, to which I now invite your attention, will help us to form an idea of the manner in which gunpowder has been gradually developed from an uncontrollable and uncertain explosive into a reliable propellant and servant.

TABLE C.—*Progressive Steps towards obtaining Gunpowders suitable for Modern Rifled Guns.*

System or method adopted.	Powder.	Result.
Change of size (Increase in).	R.L.G., introduced 1866 P. " 1871 P. ² " 1876 R.L.G. ⁴ " 1887	Diminution in rate of burning. Reduction of shock or blow given by the powder on ignition.
Change of density (Increase in).	Pebble. Prism ¹ , black. Ditto, brown. Ditto, S.B.C.	Reduction of rate of burning. Reduction of initial strain in the bore of the gun.
Change of form and moulding.	Disc. Pellet. Sphere. Cylinder. Hollow cylinder. Cube. Perforated prism.	Regularity of ballistics in units of powders manufactured under the same conditions. Final break-up along the lines of least resistance, giving additional surface of combustion and production of gas as the projectile travels along the bore.
Change of texture, granulating, and moulding.	Masses or conglomerate lumps formed of compressed grain. Progressive or Fossano Prism ¹ , black, 1881; ditto, brown, 1884; S.B.C., 1887; and E.X.E., 1887.	Regularity of density. " pressures. " velocities.
Change of composition.	Prism ¹ , brown. Ditto, S.B.C. Ditto, E.X.E. Water recognized as an ingredient.	Additional control over rate of burning, pressures, and velocities.
Blending.	P. and S.P. Prism ¹ , black. " brown. S.B.C. E.X.E.	Control over ballistics of lots or large batches. Regularity of results in batches, lots, or charges of powder.

There are only two of the methods in the diagram which our limited time will allow us to mention in detail.

The first is density, which in the modern powders has been largely increased, and is now most carefully attended to.

The workmen with the various machines take specific gravities of each batch, and these results are again checked in the laboratory.

This density, which varies in the out-turn of the same machine with every change of temperature, is a continual source of anxiety to all powder makers, and the difficulty of manufacturing within the proper limits, which are very closely defined, is considerable. This was amusingly brought before me by a leading member of one of the large private gunpowder factories, who came to consult us at Waltham Abbey about the powder he was making.

He said he was positively afraid to sit on one of his barrels of powder, on its way to proof, for fear of spoiling its density!

The actual results obtained by firing powder of different densities are shown in this table:—

TABLE D.

Density.	Velocity.	Pressure.
	Feet per second.	Tons.
1·790	2066	17·5
1·80	1944	14·6
1·82	1894	12·7

Thus we find that as the density is increased, the velocity and pressure are decreased, and that control over density gives considerable control over the velocity, and also over the pressure, or strain on the gun.

The second detail of the diagram to be brought to notice is the change of form and moulding.

It needs no explanation to demonstrate that a charge, consisting of regularly shaped moulded powder of uniform size will give (other things being equal) more uniform results than could be obtained by an equal weight of irregular grains or lumps.

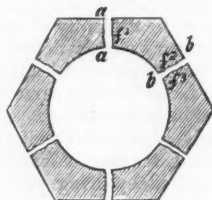
But the modern shape, the perforated moulded prism, possesses further advantages over the other forms which are worthy of consideration.

If we take any of the old grain powders, or a mass or lump like P^2 , we know that it burns from surface to centre.

This being so, the surface of combustion decreases, as the shot travels in the bore, or as the space behind the shot increases. That is to say, we find a reducing evolution of gas when you really most require an increasing one; and hence the speed or velocity of the projectile is not developed in the most satisfactory manner.

On the other hand, if we now look at the perforated prism, we find that, as the outside surface is diminished by combustion, so the inside surface of the perforation is increased; thus we see a tendency to

keep up a constant supply of the speed-producing gases; and, further, when the combustion reaches a certain point, it is more than probable that the prisms break up across the lines of least resistance, aa , bb , &c., thereby presenting twelve new surfaces, f , f^1 , f^2 , &c., for com-



bustion; fully developing the progressive character of the powder, and helping the projectile along as its speed is accelerated and the resistances which it has to overcome from friction and air are increased.

I here submit for your inspection actual portions of prisms which have been only partially consumed, when fired from a gun, and you will observe that the break up across the lines of least resistance is very clearly demonstrated.

We must now note that as the development of guns and gunpowders proceeded, so also efforts were made to design powders distinct in character and specially suited to the many weapons with which they are now employed, in charges (as I have already stated) varying from 18 grains to 960 lb.

We have in our English Services, as you all know, a huge number of guns and small-arms of different natures, each class of which requires a powder of a particular kind to develop its powers, or to suit its strength; and experience now proves that special powders must be made in order to fit or suit the various classes of highly finished and accurate weapons now in use—not only for the safety of the weapons themselves, but also to enable them to give the most satisfactory results in shooting.

For example, a heavy gun must have a comparatively slow-burning powder, as a quick small-arm gunpowder would probably blow it to pieces. Again, a small-arm rifle, if fired with slow-burning powder, would give its projectile such a low velocity as to be practically useless.

This "fitting" of powders to guns and small-arms is the manufacturer's difficulty, and has led to the comparatively long list which we have already referred to, containing fifteen different gunpowders.

5. I may here instance one of the most recent examples of fitting powder to a weapon; namely, the perforated pellet for the new magazine rifle.

The first attempts were made with all kinds of powder, from the cheapest which could be obtained from the trade, to the most expensive

sporting and rifle powders, besides those manufactured at the Government Factory. The early experiences were most unsatisfactory; irregular velocities and very high pressures being the rule; and the cheap powders demonstrated their qualities at once by the wildest shooting.

The required propellant to be used with the magazine rifle (a cylindrical pellet made from a fine-grain powder) was only satisfactorily obtained, after more than 120 distinct experiments were carried out (each involving several days' work), the velocities and pressures of all the rounds for each experiment being carefully observed and recorded.

This pellet, here shown, is now being manufactured at Waltham Abbey, and has given the best target at 1,000 yards ever obtained by a black powder.

6. I now propose to bring before you the smokeless powders; but, as there are, up to the present date, none introduced into the Services, I can only mention those which in the near future may be adopted.

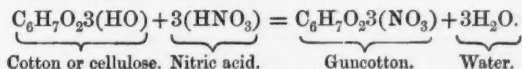
For reasons which we can all understand, I am *not* of course permitted to indicate any particular powder as that which may probably be accepted; but, as there are types of nearly every possible combination, specified in the various patents recently taken out, we can discuss some of them now with clear consciences, and without an infringing inventor's "fear of punishment or hope of reward."

I shall only very briefly allude to the character and chemical composition of these powders, as they were so fully discussed in the very able and interesting lecture given by Mr. Deering in this Institution last year,¹ and I shall therefore confine my remarks chiefly to their qualities as propellants.

These so-called smokeless powders may be classified for practical purposes under three heads, viz.:—

Modifications of

- 1st. *Guncotton*.—Trinitro-cellulose, $C_6H_7O_2(NO_3)_3$, obtained by the action of nitric acid upon cotton, viz.:—



- 2nd. *Nitro-glycerin*.— $C_3H_5 \cdot 3(NO_3)$ obtained by the action of nitric acid on glycerin.

- 3rd. *Picric Acid*.—Trinitrophenole, $C_6H_3(NO_3)_3O$, formed by boiling "carbolic acid" or phenole with fuming nitric acid.

These chemical compounds are too sensitive for use by themselves as propellants, and are, with the exception perhaps of pure picric acid, very easily detonated.

We know that some substances have only one way of burning, as,

¹ Journal R.U.S. Institution, vol. xxxiii, No. 148, p. 603 *et seq.*

for example, paper, wood, &c., which, when ignited, are quietly consumed.

Others again have two, as the ordinary gunpowders, which burn or deflagrate in air, and when confined burn with greater rapidity, causing noise or explosion.

The bases of the smokeless powders are liable to a third and more powerful action upon ignition.

This is an irresistible and instantaneous change of condition, almost without flash, or smoke, and with a sharp report quite unlike the explosion of gunpowder.

This violent action, which is utterly destructive to the strongest metal, and would blow any gun to pieces, is called detonation.

To avoid this, the substances which have been mentioned (gun-cotton, nitro-glycerin, and picric acid, &c.) are slowed, or retarded, in combustion, either by chemical combinations or mechanical mixtures with inert substances, such as gum, resin, camphor, &c., and by these means, and by very nice adjustment, the risk of detonation is averted, while the propelling power is to a great degree retained.

I may here, perhaps, mention a recent practical experience, which clearly demonstrated the difference between explosion and detonation, as usually understood, and also how these high explosives differ under different circumstances.

Some smokeless powder, made from one of the substances on the list before you, was being tested at proof.

Satisfactory results had been obtained while using one of the retarding agents; and a small charge of thirty grains gave a velocity of 2,000 feet with moderate pressure.

Three grains were added to the charge, and the thirty-three grains fired. This small quantity detonated, shattered the powerful and heavy steel breech-block of the experimental proof rifle, giving a pressure probably over fifty tons on the square inch.

The aim, therefore, in the new smokeless powders, where high explosives are used, is, by chemical and mechanical means, to render detonation impossible, and also to use a retarding or slowing agent, which will neither produce residue nor smoke, and will give high and regular velocities with moderate and regular pressures; and, in fact, convert a violent explosive into a reliable propellant.

I need hardly say that this has been, and still is, a tremendous difficulty; but, like many other difficulties, it seems now in a fair way of being overcome, by the scientific knowledge and untiring energy of those who have taken it in hand, and some of the results recently obtained demonstrate the great strides made towards obtaining the objects just mentioned.

Five rounds gave recently in the magazine rifle—

M.V. in feet.

2133

2121

2135

2106

2110

} With an average pressure of 16 tons on the square inch.

Compare this with the muzzle velocity of the Martini-Henry, 1,310 feet per second, and then we see the advance made!

If these results with smokeless powders can be regularly obtained; if the powder will keep, and always give good shooting, without too rapid wear of the barrel; if it be free from all risk of detonation under Service conditions; there seems little remaining to be desired (except perhaps that possible enemies should *not* possess it), and the sooner it is adopted the better. But when it is remembered that our ordinary peace expenditure of small-arm ammunition amounts to many millions of rounds annually, and that deterioration under changes of climate, or a serious accident at the rate of one per million, would inevitably condemn the new powder (that is to say, 20 or 30 men seriously injured by unexpected detonation), it must be admitted that those who are responsible for the introduction of these powders are bound to test them to the fullest degree before placing them in the hands of our soldiers.

7. We now come to the consideration, which is of such importance to all of us who are, or may be, users of these most powerful propellants—namely, under what conditions are they admitted into the Service, and what qualifications must they exhibit before they pass from the hands of the manufacturers, to those who may be called upon to use them under circumstances of the gravest danger to their country or to themselves?

If we examine the table (p. 268), which enumerates the conditions to be fulfilled before powders are now admitted into the Service, we observe speeds to be given to the projectile, laid down as essential, which exceed 1,300 miles an hour. They must be uniform, that is to say, the independent shots fired at proof from each batch of powder, before acceptance, must not vary from the mean of all the shots as much as $6\frac{3}{4}$ miles an hour, and the maximum variation, between the highest and lowest limit, is confined to 40 feet per second, not very much faster than the quick running speed of a man.

It should be remembered that this regularity is to be maintained, notwithstanding three other variables which may exist, viz., the manufacturing limits of the weight of the projectile, its grip, and the size of the bore of the gun.

The pressure or strain on the gun is strictly limited, and the water, or moisture to be contained, is clearly specified. The quantity of water, upon which the keeping qualities of the powder chiefly depend, is so regulated that the limits (as we have already noted) are those within which it will remain under ordinary conditions; that is to say, 100 lb. of modern gunpowder with its 1.7 to 2.2 per cent. water will retain this amount under ordinary conditions of climate; and therefore its speed-producing powers, and the pressures to be expected, are not easily affected.

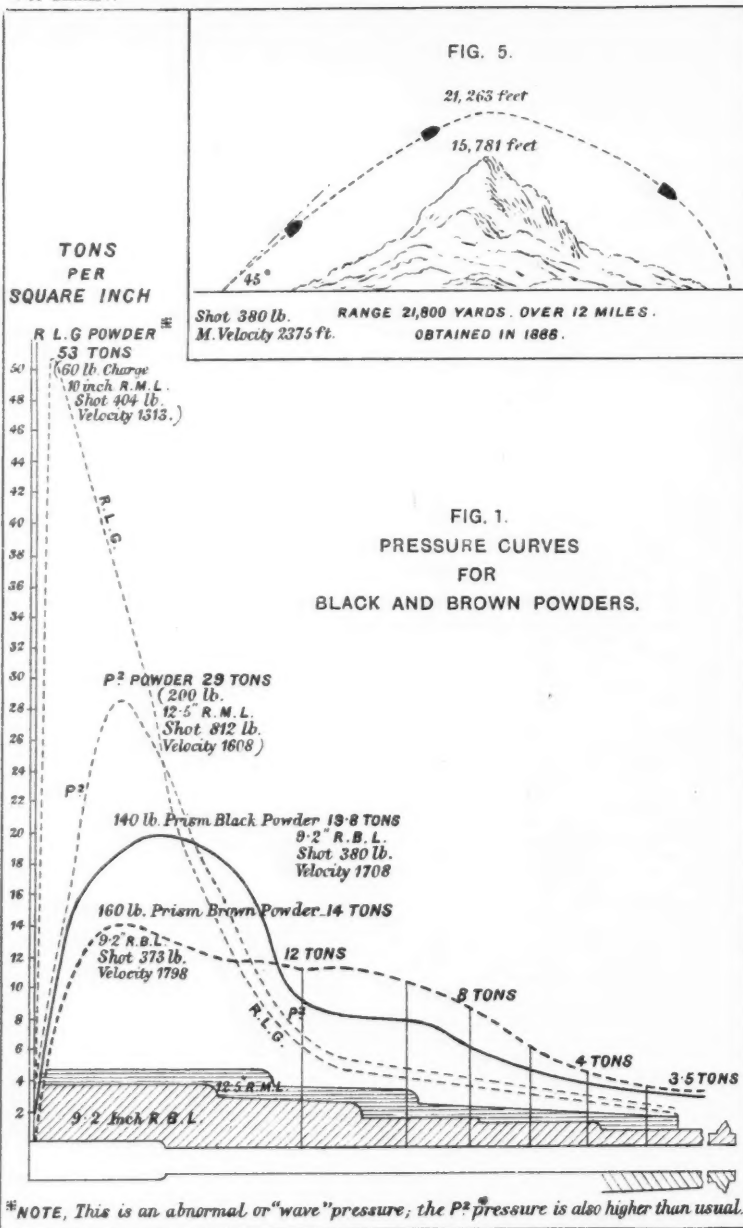
I may here note that recent practical experience proves this. Prism powder, E.X.E., sent to India for two years, gave on its return home almost the same results as those which were recorded when a portion of it was fired before leaving England.

On the other hand, it is well again to be reminded that if unduly

TABLE E.—*Showing the Conditions of Acceptance of Service Powders.*

Nature.	Small-arm or gun in which fired.	Charge of powder.	Weight of projectile.	Density.		Moisture.		Muzzle velocity.		Pressures.		Remarks.
				Min.	Max.	Min.	Max.	Min.	Max.	Max.	Mean.	
R.F.G.	Snider rifle	70 gr.	480 gr.	1.58	1.62	per cent. 0.9	per cent. 1.2	f.s. 1250	f.s. 1290	Tons sq. in.	Tons sq. in.	"Rifle pistol," hav- ing the same density and moisture as R.F.G., should give a muzzle velocity of 680 f.s. when fired in 18-grain charges from an Enfield pistol.
R.F.G. ²	M.H. rifle	85 gr.	480 gr.	1.72	1.75	0.9	1.0	1310	—	—	—	
M.G. ¹	1-in. Nordenfält	625 gr.	3,170 gr.	1.75	—	1.0	1.2	1290	—	—	—	
*Q.F. ¹	6-pr. Hotchkiss Q.F. gun.	1 lb. 15 oz.	6 lb.	1.75	—	1.0	1.3	1420	—	12	14.0	
								1800	1840	14.5	14.0	
R.L.G.	9-pr. M.L. gun	1½ lb.	9 lb.	1.67	—	—	—	1385	1435	—	—	† These velocities are over 1,360 miles an hour.
R.L.G. ²	13-pr. M.L. gun	3¾ lb.	13 lb.	1.65	—	1.0	1.3	1540	1590	16.5	16.0	
R.L.G. ⁴	6¼-pr. M.L. gun	11 lb.	67½ lb.	1.65	—	1.0	1.3	1380	1420	17.0	16.5	
P.	6-in. B.L.	34 lb.	80 lb.	1.75	—	1.0	1.3	1890	1930	16.5	16.0	
S.P.	12-pr. B.L.	4 lb.	12½ lb.	do.	—	do.	do.	1700	1740	15.0	—	
P. ²	12½-in. M.L.	200 lb.	812 lb.	1.75	—	1.0	1.3	1540	—	22.0	21.0	† These velocities are over 1,360 miles an hour.
Prism ¹ -black .	8-in. B.L.	100 lb.	210 lb.	1.76	—	1.0	1.3	2000	+2050	18.0	17.5	
	11-in. B.L.	55 lb.	100 lb.	1.80	—	1.7	2.2	1960	+2000	16.5	16.0	
Prism ¹ -brown	11-in. B.L.	295 lb.	655 lb.	do.	—	do.	do.	1980	+2020	18.5	18.0	
Prism E.X.E. .	6-in. B.L.	48 lb.	100 lb.	1.80	—	1.5	2.0	1960	+2000	17.5	17.0	
Prism S.B.C. .	11-in. B.L.	360 lb.	655 lb.	1.85	—	1.7	2.2	+2010	+2050	16.5	16.0	† These velocities are over 1,360 miles an hour.
S.A. Pellet	Magazine rifle.	71½±2½ gr.	215 gr.	..	..	0.9	1.3	1850 ±50	1850	20.0	19.0

* The size of Q.F.¹ powder is ½-inch square by ⅜-inch thick; about 270 pieces to 1 lb. It is manufactured by the trade.



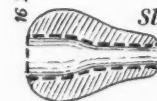
Probably 150 Tons per sq. inch.



53 Tons per sq. inch.



16 Tons per sq. inch.



EXPLOS

GUN

HIGH EX

GUNC

EXPLOSI

R. L. G.

Rifle Large

60 lb Cha

PROP

PRIS

Slow Bu

360

FIG. 2.
EXPLOSIVE AND PROPELLANT
EFFECT ON
GUN AND PROJECTILE.

HIGH EXPLOSIVE
GUNCOTTON.

GUN BURST
M.V. ALMOST NIL

EXPLOSIVE

R.L.G.
Rifle Large Grain
60 lb Charge.

M.V.
1313

PROPELLANT

PRISM'S.B.C.
Slow Burning Cocoa.
360 lb. Charge.

M.V.
2040

FIG. 3.
GUNPOWDER TREE,
BLACK.

PRISM² BLACK

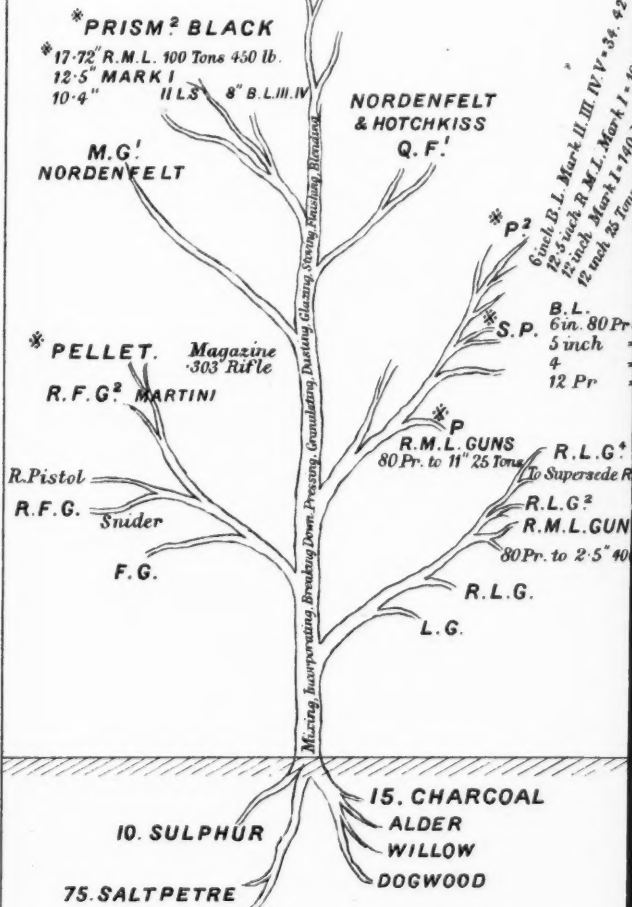
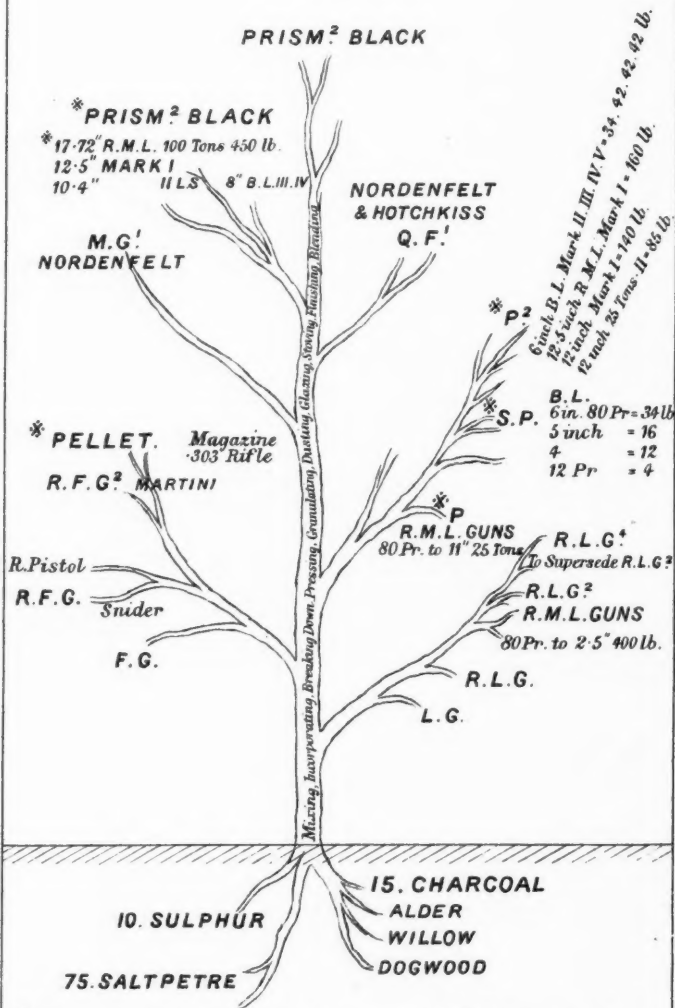


FIG. 3.
GUNPOWDER TREE,
BLACK.



* These Charges are undergoing modification Vide Brown Powder.

FIG. 4.
GUNPOWDER TREE,
BROWN.

QUICK FIRING

E. X. E.
W. A.

To Supersede P² Prism¹ Black Prism² Black

PRISM¹ BROWN
ROTTWEIL

S. B. C.
W. A.

111 Ton
16.25" B.L.
960 lb.
68 Ton
13.5" B.L.
630 lb.

PRISM¹ BROWN
WESTPHALIAN

PRISM¹ BROWN
W. A.

9.2 B.L.
Ia II = 144
III. IV. V = 175
10" B.L.
12" B.L.
16" R. M. L. 80 Tons
450 lb.
8" B.L.

3. SULPHUR

79. SALTPETRE

1.7 to 2.2 WATER

Straw

Oxygen

Hydrogen

Carbon

18. CHARCOAL

Mixing, Incorporating, Breaking Down, Pressing, Granulating, Drying, Moulding, Stowing, Blending

dried, and artificially heated or wetted, it is as liable to give irregular results as the engine whose boilers are subjected, at one time, to forced draught and undue production of steam, and, at another, to the failing supply which smouldering fires and neglected stoking will produce.

It is therefore most necessary to attend to the condition of our modern propellant, and after its issue to the Services, the water question is the chief one.

The powder should be kept from *undue* influence of moisture, and should not be exposed to conditions which may tend to drive the proper quantity of water out of it.

Frequent examination, as laid down in the regulations, is necessary, and facilities, which should be utilized, are now afforded at home and abroad for testing the moisture, and informing us as to the condition of our propellant.

8. We are now in a position to consider the *practical* results which have recently been achieved, and by again comparing the powers and characteristics of the old explosive with the modern propellant, we shall more fully emphasize the claim which is submitted for modern gunpowders in this lecture. The diagram of pressure curves presented in Plate 3, Fig. 1, indicates pretty clearly the difference in the character of the old black, and modern powders.

Two guns, a heavy muzzle-loader and modern breech-loader, are shown in section. Both are perforated at certain points along the bore, and pressure gauges are inserted.

A vertical scale of half-inches is adopted, and the number of tons pressure recorded by the various gauges at the different points is measured vertically for each nature of powder and gun.

By joining the points (marked 12 tons, 8 tons, &c.) which represent the pressures, curves are obtained which show, in a pictorial form, the actual pressure curves or strains to which the guns are subjected.

Thus, in the first instance, the suddenly rising and rapidly falling dotted line represents the enormous pressure of 53 tons per square inch, sometimes produced by old black powder—Rifle Large Grain, while the shot only attained to a velocity of 1,313 feet.

The other intermediate curves tell a similar story, but at the same time indicate great progress.

Now, look at the heavy dotted line, the pressure curve for brown powder, and you see the curve of a true propellant. Here we see a pressure of 14 tons gradually produced, and slowly diminishing towards the muzzle of the gun. In fact, we see the pressure developed by the propellant adapting itself to the strength and form of the gun in which it is used.

To demonstrate the *regularity* of modern gunpowders, I here select two, designed by Colonel W. H. Noble, Superintendent R.G.P.F., as being typical of the reliable propellant class; and I submit that the results shown on the table before us speak for themselves.

They were obtained at ordinary and recent proof of Waltham Abbey gunpowder carried out independently at Woolwich.

TABLE F.

Nature and charge.	M.V. in feet per second.	Rate per hour in miles.	Mean error in miles per hour.	Chamber pressure in tons per square inch.	
S.B.C.	2004	1366	0·47	14·9	
W.A.	2003	1365	0·23	14·8	
360 lb.	2003	1365	0·23	14·9	
E.X.E.	1961	1337*	0	14·1	} *Fractions omitted.
W.A.	1964	1339	2	13·8	
48 lb.	1960	1336	1	14·0	

There is another result, which although hardly within the scope of this lecture, ought not to pass without notice, as it shows in an interesting manner what modern guns with modern gunpowders are capable of doing.

If we could imagine the highest mountain in Europe, Mont Blanc, placed between us and Woolwich, a shot which was fired in July, last year, would have passed 5,482 feet above its summit, and lodged, on the other side, in Woolwich. (Fig. 5.)

To recapitulate:—

We have seen that the old black powders were unrestricted as to pressures. The strains to which they subjected the guns were not at first known; and when they were discovered, they were found to be very high and irregular.

The modern powders give low and regular pressures.

Again, if the velocities produced by the old powders reached a certain height they were considered satisfactory, and the powders passed into the Service.

Now, a high and low limit of speed are closely defined, and the low limit is in most cases nearly half as much again as that obtained not many years ago.

Further, the uniformity of results cannot fail to strike any careful observer.

Take as examples those already quoted or the modernized type of pebble, viz., "Selected Pebble," which at recent proof gave in consecutive rounds:—

TABLE G.—*Waltham Abbey Selected Pebble.*

Gun.	Muzzle velocity.	Mean variation.	Chamber pressure in tons.	
	feet per second.			
80-pr. B.L.	1925	1	15·1	3 consecutive rounds fired in 6-inch B.L. 80-pr.
	1925	1	15·35	
	1921	3	15·0	
12-pr. B.L.	1711	1	12·9	5 consecutive rounds fired in 12-pr. B.L.
	1711	1	12·6	
	1717	5	12·6	
	1718	6	13·3	
	1714	2	12·5	

When we consider such results as these, together with those previously noted, I submit that the claim of modern gunpowder to be a "reliable propellant" (or "trustworthy speed producer, properly under control") must be admitted as fairly established.

At the same time it must be *constantly* borne in mind that these results can only be maintained by unremitting care and attention to the condition of our guns, our projectiles, and our gunpowder.

In conclusion, I would point out that where great results are obtained, great efforts and care have been bestowed. Each gun fired, and every pound of gunpowder expended (even when one charge alone contains 1,000 lb.), represents a large amount of thought, calculation, and labour.

The efficiency of the best of our guns is dependent upon the quality and condition of the powder employed as the propelling agent, and the proper and intelligent use of the ammunition supplied.

I, therefore, submit that a sound knowledge of the general principles which govern the manufacture of gunpowder is most useful; and that a *special* knowledge of the best means suitable for its care and preservation as a propellant is indispensable for those whose duties may call them to any quarter of the globe, and who belong to Services whose responsibilities are so closely connected with the honour and safety of our British Empire.

Mr. SPON: I do not rise with the intention of occupying the time of your meeting by offering many remarks upon this interesting paper. I rise for the purpose of opening a discussion upon a subject which is to me a matter of daily experience, as it is with Major Barker. Personally I have to thank Major Barker very much for this interesting paper, and for the clear and lucid way in which he has placed all the difficulties of the problem before us, and the general position of affairs. I may say that very few people are aware of the instant and constant attention that the different minutæ of the manufacture of wood-powder has placed upon those responsible for that, and I have never heard a more lucid explanation than that which Major Barker has put before you. At the same time, I thoroughly agree with Major Barker that the modern explosive powders, although not what the

department possibly might demand with regard to each of their conditions, are still advanced a long way further than most people imagine. I must caution you particularly against paying any great attention to the information you obtain from pamphlets, for it is a well-known fact that a man who has anything valuable, particularly so valuable as to be embodied in a modern patent, does not embody all his experience in a sixpenny pamphlet, to be published for the benefit of Tom, Dick, and Harry. The encouragement to do so is not great, and the most valuable pamphlets upon explosives are those in which a very little has been said, but a very great deal has been inferred. Then as regards the inventor: there is one thing I should mention as a matter that came under my own experience the other day, dealing with this question of the modern smokeless powder. I had a powder, not any particular powder—I mean to say it was not with any object specially devoted to the test, but with a smokeless powder, I kept it under a temperature of 150 degrees Fah. for eight days (night and day), and I fired it as nearly as possible at that temperature. After the first three days it was fired and tested, and the increase in pressure, I am bound to say—the pressure was about 18 tons—was only 1 ton. It was tested after five days, and the increase in the pressure was then about 2 tons; it was tested after seven days, and the increase was 3 tons, so that we have not got to anything like the dangerous extent of detonation. I mention this not as showing that this was a particularly good powder, but only as showing that the time has come when we shall produce a powder that will fulfil varied conditions, and the conditions which the powders of the English Services, to a greater extent than other armies, have to fulfil. I mean particularly under the influences of the very varying temperatures that they must be subjected to in service from the Arctic Regions to the Torrid Zone.

General Sir BEAUCHAMP WALKER, K.C.B.: I should like to ask Major Barker one or two questions. Last summer I was passing my time in Germany, when an employé of the house in which I was living came back from the autumn manœuvres, and almost the first question his master and I asked him was about the smokeless powder. His answer was very plain: it stank to that extent that the men could hardly remain in the ranks. I wish to ascertain, if possible, whether Major Barker can give us any information on that subject, whether that foul smell is observed in the smokeless powder manufactured in England?

Mr. SPON: May I offer some explanation of what has been asked by Sir Beauchamp Walker? I also was very much interested in the amount of smokeless powder at the German manœuvres, and made particular inquiries in Berlin through my friend as to what the smokeless powder was. I was given to understand that the smokeless powder was the batch of powder not fit for use in the Army. It was made up into blank charges, with the result, as always happens with blank cartridges, that there was very little smoke and very little noise. It is not to be presumed that any army will fire during their manœuvres, or for the mere purpose of practice, use tons and tons of the most valuable material that they can possibly produce; and this actually was the fact.

General Sir BEAUCHAMP WALKER: I am rather surprised at hearing this, because I followed the course of the autumn manœuvres in Germany last summer, so far as the papers informed me, and I found that the Emperor, a very clear-headed and a keen young soldier, considered the question of smokeless powder to be of such importance that he on one day took under his own command an army corps provided with smokeless powder, and on the following day took command of another army corps which was provided with the old powder. Now, I can hardly think that the Emperor would have taken such an extreme measure as himself taking the command of an army corps provided on two separate days with the two rival powders, unless the new powder had been a powder of a reliable nature; otherwise the experiment would have been worth nothing.

Mr. DOUGALL: With reference to that point I will only add one word, to say that at a sham fight bullets are not fired. It is a fact which Major Barker and others well know, that with these new powders the action when no bullet is in front of the powder is totally different from the action when a bullet is in front. The use of smokeless powder for a sham fight adds no information of any value as to the quality of the powder, and as there is very little noise produced, as Mr. Spon has

remarked, practically the only use of a sham fight with the smokeless powder is to see to what extent the powder does or does not create smoke. I should like to ask one question with reference to the velocities the lecturer gave of the magazine rifle, of over 2,100 feet with an average pressure of 16 tons on the square inch. That is, compared with the velocity of the Martini-Henry of 1,310 feet per second; but it does not state what the pressure of the Martini-Henry is when the muzzle-velocity of 1,310 feet is produced with black powder. Perhaps the lecturer would have no objection to give that. Also, I would ask, if these powders which give the 2,100 feet in the magazine rifle, have ever been used successfully in the Martini-Henry?

Mr. QUICK, Fleet Engineer R.N. (retired): I am very glad to have heard the lecture this afternoon. I came somewhat disposed to dispute some of the points with regard to these new powders, for I must say I am rather strong at present in favour of an old friend—the old black powder—because I found it was remarkably clean, and it possessed the great merit of stability. We know that chemical changes sometimes take place in compounds. We know that chemical changes have taken place in metals, even such as in brass and other alloys; and with regard to powder, I have known that compounds which have answered admirably for a month, or even for two years, will then change, and that they will answer well on some foreign stations but not on others, the only reason that it could be put down to, being some difference in the electrical conditions of the atmosphere, or something that we do not know anything at all about, but certainly not to heat or damp only. I know one case in which some primers, which had been kept carefully under seal, were taken out of the magazine for the purpose of firing a salute. They were carefully dried and warmed, and yet, notwithstanding all precautions, they were found useless. This must have been owing to some mysterious change which took place in the material, owing perhaps to age, a thunder-storm, or some peculiar atmospheric condition. I allude to this because I say that when we go into these new chemical compounds, we go into a very difficult and dangerous field indeed. I am myself interested in a smokeless powder, but it is a very difficult thing to deal with. We have to look forward to changes which may take place in different temperatures and different climates: powder may stand one test but not another. The old, small-grain powders, giving high pressures, were used first of all in the new guns, and then, to overcome the difficulty of the high pressure, we increased the size of the grain. Finding that did not answer altogether in reducing the pressure sufficiently, we increased the size still further, with the result that much powder was blown out of the guns unburnt. If a shot has to attain a velocity of 2,000 feet a second, and you have a gun 7 feet long, your powder must be burnt very quickly. If you double the length of gun and have it 14 feet long, you may double the time of the combustion of the powder, and again increasing the length of the gun to 28 feet, you may double the time of the combustion of the powder to suit the increased length of gun. It then becomes a question how are you to get a powder to burn exactly the right length of time? If you have large-grain powder it is blown out unconsumed, if you have small-grain powder you get enormous initial pressures. I have studied the subject for twenty or thirty years, and therefore I begin to fancy I know a little about it. An old invention of General Rodman's—the perforated powder—which you all know, seems to me to be the proper thing if it were perfectly worked out. You know it is a very difficult thing, as has been said before, for inventors or people to make a decent powder. My first trial in making powder was for our 12-pounder gun, and I went to Messrs. Curtis and Harvey and talked to them about it. They asked me, had I gone there to teach them to make gunpowder? I said, "I do not know yet." They said, "Have you ever been in a gunpowder factory?" I said "No," but I said, I think, "We will go and have a look and see if we cannot make powder in a better form than has been done hitherto." After a little opposition, Curtis and Harvey came to my assistance, and worked with me to produce perforated cakes of black powder. We did not want to do anything dangerous, and therefore at first we used a very high density. The first results were that we got a low velocity and low pressure, and we could not burn the powder in the gun because the density was too high for the length of the gun. The next thing we got at was, we fixed the charge at $6\frac{1}{2}$ lbs., and with a 12 $\frac{1}{2}$ -lb. shot we obtained velocities of

2,080 feet, 2,081 feet, and 2,094 feet, thus showing good uniformity, although there was some little variation about the weight of the shots—with a pressure of only 14 tons to the square inch. That shows what can be done with black powder. We altered the density, and made several different experiments, but we got no better results; we did not get, in fact, so good results as we lowered the density beyond a certain point. We found that 1.75 was the best density for that gun.¹ That shows how much influence form has on the combustion of the powder. If you take the old 2-inch cubes, the area of initial combustion is, for 100-lb. charge, 4,800 square inches. If you have 1-inch cubes you have just double the area of initial combustion surface, that is 9,600 square inches per 100-lb. charge, and you reduce the time of burning and increase the pressure. What I wish to point out is simply this, that a special powder should be made for every different length of gun. Now, the lecturer has agreed with this view, but hitherto I have been met with this opposition: "Mr. Quick, your powder will never be adopted, and it cannot be used because you must have a powder that is interchangeable for every gun in the Service. That is a fatal objection." I said at once, "But have we shot that are interchangeable? Does the shot for the 100-ton gun fit the Martini-Henry rifle or the 12-pr. gun?" Well, no, it does not, certainly. Then I said, "Why, if you have a special shot should not you have a special powder for every gun?" Oh no, that was the obstacle, that it was not interchangeable. There is one point I want to find fault with in our present powders—these hexagons, so far as I can see, are made all over-size. The material is the same. They are to be used in different guns—that is radically wrong.

Major BARKER: Is the material the same?

Mr. QUICK: It is the same, or you have to vary the material, and therefore you have not interchangeable powder, nor even uniformity of material. If you vary the material you run into new dangers. If you could get one good, sound, reliable material for your powder, and then make it in such a form that it will burn a given length of time, suitable for every gun, you will get an approximately perfect powder. An absolutely perfect powder would be a powder that would give an equal pressure right away up the bore; instead of that red line in the diagram being, as it is, a curve, you would get a straight line right up to the muzzle.² And then you should have a thick and heavy muzzle to resist the pressure, thus reverting to the oldest form of gun. If you have a thin chase it is easily damaged. It may be said that I am talking speculatively, because it is not practical altogether what I am saying, but we must always look at some ideal as to what is possible to be aimed at, although it may be impossible to attain fully. If you had the old-fashioned powders, with the high pressure only in the chamber, you could thin off your muzzle, but you cannot do it nowadays with the new powder; it would blow the muzzle off. You have not been into action as yet with these long guns, and if they come to have their long and thin muzzle struck by ever so light a projectile you would have your guns disabled.

¹ The largest charge of S.P. powder (such as is used in the Government 12-pounder) we could get into this gun weighed 5 lbs., and the highest velocity we got with that powder was only 1,818 feet per second.

² The following extract from a paper, written by me some time ago, and published in the "Proceedings of the United States Naval Institute," Vol. XV, will show clearly what my views of an ideal propelling agent are:—"Now, an absolutely perfect propelling agent (which of course is only imaginary) would be a material which would occupy, say, one-thousandth part of the length of the bore of the gun (no chamber being required) which material should give off such a volume of permanent gas (without colour, smell, or active chemical properties) at such a rate as would give an uniform pressure of, say, 15 to 20 or 30 tons per square inch throughout the whole length of the bore of the gun; the temperature of the said gas not exceeding, say, 500° to 1,000° Fah. Such a propelling material we certainly have not at present, nor is there any prospect of its being obtained." Nevertheless, we should try to approach it as well as we can, and be careful not to sacrifice the stability and uniformity of action of our propelling material for the attainment of some one particular quality, such, for instance, as smokelessness.—G. Q.

If you had a thick gun it might possibly resist the blow. The point I wish to come to is that if you got good material you could alter the size of your prisms, or, better still, make the material up into a solid cake with perforations suitable to the length of the gun. Of course, you make the cylinder of propelling material the proper size for the chamber. You take these hexagons, and you put them into a bag; there is no cohesion, no rigidity; if the charges are knocked about you get the corners rubbed off the prisms, the cases and bags cut, and other little disadvantages, which our Chairman, no doubt, knows all about much better than I do. That is a point we have to consider, the behaviour of gunpowder on board a ship rolling about at sea.¹

Major-General WARDELL: I should wish to say only a few words, since it is not for me to make any reply to what has been said concerning the able lecture we have listened to. I was, however, glad to hear General Rodman's name mentioned in the discussion, because I think the debt we owe to him has never been adequately acknowledged. I look upon General Rodman's experiments, which are detailed in his book "*Properties of Metal for Cannon, and Qualities of Cannon Powder*" (Boston, 1861), as the basis of our prismatic powder. He called his powder *perforated cake cartridge*. It was made in discs the size of the bore of the gun. The discs varied in thickness for the gun required, and they were perforated with longitudinal holes parallel to the axis of the piece. He carried on a great many experiments with this powder, and finding that these discs were certain to break up more or less in transit, he divided them into hexagonal prisms which fitted closely together, in order that there should be due control over the form of the powder. I believe I am correct in stating that prismatic powder, first of all known as "Russian" prismatic powder, was introduced into Europe by a Russian Military Commission, which visited the United States about the time of the Civil War, adopting General Rodman's idea. In his work already referred to he demonstrated the mathematical theory of the powder, which has been so ably touched upon by Major Barker in his paper, and of course he also proved his case experimentally. Perforated cylinders of powder, not in discs, have also been tried, about which Major Barker perhaps can tell us something. There is another point I should like to touch upon. At the present time, I suppose the most interesting subject connected with gunpowder as a propelling agent is that of smokeless powder for magazine rifles, and all over Europe, and in America also, experiments have been tried in that direction. I am very glad to hear that even those gentlemen who clearly have an opinion that smokeless powder must come, dwell upon even the distant chance of "detonation" as a very real and a very great danger. There can be no doubt some of the accidents of which we have heard with sporting powders, prepared from the higher explosives, have occurred from detonation; the breech of the gun being blown to pieces, in some cases accompanied by personal injury. These accidents have been usually attributed to defects in the metal, but I believe, from investigations I have made, that they were really the results of detonation. So that quite apart from all the changes which can take place in the powder itself in different climates, it is of course a very important matter to have one which would be perfectly safe from the danger of detonation.

Admiral COLOMB: I should not like the discussion to close without expressing, as more or less of an outsider, the very great pleasure with which I have listened to this lecture. I have seldom heard in this theatre a lecture on an intricate subject so lucidly prepared, and with such admirable illustrations. It is one of those useful

¹ With reference to the liability to injury of hexagonal or prismatic powder, due to the sharp edges and corners of the prisms, it is stated in "Extracts from the Proceedings of the Department of the Director of Artillery" for 1887, Part I, page 21, that, on the examination of some powder charges at Gibraltar, the Inspector of Warlike Stores, "found the powder to be very dusty and an amount of dust had worked through the bags Some prisms were much broken The cartridge was unserviceable." Powder cakes, properly cemented together to form cartridges, would not be liable to such injury and deterioration.—G. Q.

papers that people will refer to over and over again in the Journal, although it is not of a controversial character, such as we sometimes wish to see in this theatre. Only last week, with reference to an explosive—not a propellant—with which I am connected, roburite, we had before us the consideration of the part that water played, and it was pointed out to me then, for the first time, the part that water played in gunpowder as a propellant. And we have found that even in the high explosives water must not be absent, that the high explosive is irregular in its action when a certain proportion of water, what proportion I do not know, is absent.

Colonel NOBLE, Supt. R. G. P. Factories: My friend, Major Barker, at the commencement of his lecture said that he was going to address the consumers of gunpowder. Now, Sir, as I happen to be a manufacturer, perhaps I am a little out of court. However, I wish just to say a few words from the manufacturer's point of view. We manufacturers of gunpowder are, if I may say so, in the same boat as all other manufacturers to this extent, that we very naturally wish that the goods which we produce should be appreciated by our customers. But, Sir, in the same way as other manufacturers, once these goods leave our factory we have no further control over them. We cannot tell what is going to be done with our powder after it has left us. Well, Sir, supposing that you go to your wine merchant and that you buy a sample of a high class wine, and that you bring it home, and instead of putting it in a nice, cool, well-ventilated cellar you put it into a little cupboard next the kitchen boiler. Do you think that it would be fair to go back to that wine merchant, in a year's time or so, after you had found that the wine had perished, and abuse him? Now I have got a fellow-feeling for that wine merchant, because, so far as I can make out, my friends in the Navy keep my gunpowder in a little cupboard next the kitchen boiler.

Major BARKER: Gentlemen, I have to answer the questions which you have been good enough to put to me, and to thank you for the interest which you have taken in my small effort to lay this subject before you. I have first on my list, Mr. Spon. He mentioned the variable conditions to which these modern propellants, both the smoke-producing powder and the smokeless powders, are subjected, and he also mentioned, from his own experience and from what he believed to be the result of his own experiments, that those variable conditions due to the very great changes of climate to which all our propellants are subjected, will be overcome. I quite agree with him; I think that this is most probable. I next answer Sir Beauchamp Walker. He was good enough to tell us about the experience that he had in Germany, and he asks what the influence of the smokeless powders might be on the troops employing them. Well, I should like to classify the reply under two headings. First, as regards the smell. I am not aware of the physical characteristics of Sir Beauchamp Walker's informant, but I can only say, from my own experience and from what one sees in this country, that our people are not so very sensitive to smell on the field of battle or during experiments. But there is, no doubt, a serious side to this question. If the smell is injurious to the health and safety of the troops employing the powder, of course it must be recognized, and a powder must be obtained which will not give off these noxious fumes to disable our troops actually before they come to the brunt of the battle. There is another point that Sir Beauchamp Walker mentioned, which was, that this powder was apparently tried without projectiles. Of course, we all know that firing blank ammunition, or preparing ammunition to fire without projectiles, is a very easy thing. Almost any child can prepare the old gun-cotton to fire as a blank cartridge. But the question comes, then, can you prepare it so as to give the velocities required without straining the rifle? and that is, of course, a consideration for the immediate future and of the present. As I told you in my lecture, there have been magnificent results obtained, but whether they are to be permanent or not, one can hardly say. Mr. Dougall mentioned this question of the blank being used, and stated that the firing of blank ammunition was no criterion of the value of the powder employed. We all agree in that. He also asked the pressure in the Martini-Henry with a velocity of 1,310 feet per second. When the original specification for this powder was drawn up, we had not any data. As you all know the recording of pressures is a very modern invention, and I cannot give you the exact pressure obtained with the old powders used in the Martini-Henry, but the black powder pressure is out of proportion to the modern

pressure of the present day, Perhaps Mr. Rigby, Superintendent Royal Small-Arm Factory, could give us the pressure.

MR. RIGBY : It is about half the pressure generally of the magazine powder.

Major BARKER : Mr. Rigby kindly informs us that it is about half the pressure. With regard to the question whether the smokeless powder has been used in the Martini-Henry, I regret to say I cannot answer it. Mr. Quick mentioned the failing of primers, but I should like him to let me know (he is, of course, aware that there are numbers of different kinds of primers in the Service) what kind of primers were actually used.

MR. QUICK : The quill friction-tube.

Major BARKER : Well, I can answer Mr. Quick from my own experience, because we have had the testing of these quill friction-tubes for a number of years. These quill friction-tubes are liable to deteriorate from climate, from chemical action, and from wet, and you cannot restore them by drying them and heating them, or toasting them over a fire.

MR. QUICK : They were never allowed to get wet; they were kept in the magazine in hermetically sealed boxes and never opened.

Major BARKER : The copper friction-bar sets up a chemical action with the detonating composition, and that is what injures the friction-tube.

MR. QUICK : There is a change takes place in the detonating composition.

Major BARKER : The composition is not, in any sense of the word, the composition that is used in the smokeless powder.

MR. QUICK : Certainly not; I referred to the serious chemical change. You can transport claret to England with advantage, but Burgundy you cannot; there are certain mysterious changes; it does not improve. So there may be with these new compounds. The only point I wish to raise is the necessity of caution.

Major BARKER : Quite so. I admitted that. Mr. Quick also suggested that the powder should be made to fit the gun to a certain extent, and not be interchangeable. Of course, in the paper I have had the honour of reading, I suggested that myself. There was another recommendation made by Mr. Quick, namely, that the material should be the same in all prisms for charges of powder. It is difficult to see the advantage of this. If you are *not* to have an interchangeable powder, why should you have the same composition throughout all the powders? The material is *not* the same in all the prisms. In the black prism there is 75 per cent. of saltpetre, and in the brown prism there is 79 per cent. The prisms are the same in shape and size, but they are suited for different guns. They have different marks on them, to distinguish one from the other in use with the different guns. There is one other question Mr. Quick brought before us, which was, that an equal pressure should be exhibited right along the bore, and equally thick guns from muzzle to breech introduced. All of us who have anything to do with guns—in the moving, the firing, and the working of them—can see that this is quite impracticable.

MR. QUICK : I said the ideally perfect powder.

Major BARKER : Well, my ideal, with all due submission to those here present, is that the ideally perfect powder should suit the form and strength of the gun in which it is used. The gun is built for use in our extended services, naval and military, and of the most convenient form that can be applied, both at sea and on land. Then we make the powder to fit the gun. We have the greatest strength of gun at the breech, and the greatest pressure of the powder at the breech, and as the gun necessarily must be light at the muzzle, we reduced the pressure towards the muzzle.

MR. QUICK : In the Navy (and in the newspapers also) it is pointed out that the great length of the gun is a great inconvenience. If you carried your pressure of 20 or 16 tons right away from breech to muzzle, you could have a very short gun and you could have a gun of no greater weight, in fact of less weight, than you have now and with equally high velocity. You would have a short gun, but a strong gun. It would be an ugly gun, but it is the ideal gun. I have heard naval Officers say "Give us a short gun," and I think there cannot be two opinions about the convenience of having short guns on board ship.¹

¹ Some of the new guns made in France and in the United States are 50 calibres in length and upwards.—G. Q.

Major BARKER: There is one other objection to Mr. Quick's suggestion, and that is the ultimate limit of strength of the material. No gun that ever was designed will bear the strain that is required to give in a short length the tremendously high velocities which we have on this diagram. Mr. Quick made one more suggestion that prisms are a bad form, and liable to injury in rolling about. If the Chairman will allow me to put these prisms together I can demonstrate at once that this is not the case. We are all well acquainted with the honeycomb, the most stable form of hexagonal prism packed together without waste of space. We find a cartridge properly fitted with prisms is much less liable to knocking about and injury than a cartridge packed with P_2 lumps of powder. General Wardell mentioned General Rodman's perforated cake cartridge, which was mentioned also by Mr. Quick. I happen to know that the present Superintendent of the Royal Gunpowder Factory carried out some experiments with perforated cake cartridge in the early part of the sixties, but they were found by English artillerymen not to answer. These cake cartridges are not used in the various Continental Services.

General WARDELL: I only referred to that as the real origin of the discovery of the prismatic powder.

Major BARKER: General Wardell only referred to it as the origin, but Mr. Quick recommended it as an advantageous and good form. Colonel Noble tried it, and it was said that before it arrived at its destination, it broke in pieces. Admiral Colomb mentioned roborite (and was also good enough to refer to my lecture, for which I thank him sincerely). He spoke of the influence of water in roborite. I am quite sure that the influence of water in these smokeless powders will have to be considered. Whether it will be of great importance I am not prepared to say. I think the remarks of Colonel Noble, the Superintendent of the Royal Gunpowder Factories, speak for themselves, and I thank you all for the attention with which you have listened to the lecture.

The CHAIRMAN: Gentlemen, before thanking our lecturer, I must express my regret that the gallant Officer who was to have taken the chair to-day is through illness unable to be present. No doubt General Brackenbury's remarks would have been very interesting and valuable, and we have not the benefit of his experience. I will make only one remark with regard to smokeless powder. Smokeless powder was referred to by one speaker in connection with magazine rifles. No doubt it is important for future use with magazine rifles, but really it becomes a necessity when quick-firing and machine guns come into operation. Whether for larger guns smokeless powder will be an advantage to the attacker or the attacked, either by land or sea, I believe must be a matter only to be settled by experience hereafter. As to the detrimental results accruing to gunpowder when stowed in the magazines of H.M.'s ships there can be no doubt. It is a subject that should be brought to the notice of our naval constructors, with a view to protecting in some way ships' magazines from the great changes of temperature and amount of moisture to which, from their proximity to boilers and engines, they are exposed. I scarcely think this point has received sufficient attention hitherto. All I can say now by way of finishing is, that I thank very much our lecturer, both in your name and my own, for the masterly way in which he has dealt with this subject. Having heard from him to-day of the progress that has of late years and is still being made at the Government Factories at Waltham Abbey, and the observations of the gallant Superintendent of that establishment, I think we may rest satisfied that the powder question is in good hands.

Friday, February 7, 1890.

GENERAL THE RIGHT HON. VISCOUNT WOLSELEY, K.P., G.C.B.,
G.C.M.G., Adjutant-General to the Forces, in the Chair.

RANGE-FINDING; ITS DESTINED EFFECT ON TACTICS.

By Lieutenant-Colonel A. W. WHITE, R.A.

LET me begin by explaining that I am not about to weary you with the technical details of range-finding instruments, still less to propound any original theory of tactics. All I purpose to do is to bring the subject of range-finding before you, as a satisfactory solution of certain military problems of primary importance, and with this end in view to state concisely what can now be accomplished by its aid, so that you may judge for yourselves whether my conclusions are reasonable or not.

First, then, I will remind you of some prominent features in the tactics of the present day, which are distinctly traceable to the difficulty of correctly estimating time and distance on the field of battle.

Next, I will bring to your notice some facts about range-finding which seem to indicate how that difficulty *will be*, and in fact *is*, already overcome.

Lastly, I will submit to you, as matter for discussion, the tactical significance of the situation thus created.

I. THE TACTICS OF TO-DAY. (THE DIFFICULTY.)

The Controlling Influence.

The general principles of war, we all know, never have changed and never can change; nevertheless, its methods have always varied in immediate response to the progress of mechanical invention.

It is very usual to ascribe the tactics of successive periods to the influence exerted by the Generals of the time, whereas it would perhaps be nearer the truth to attribute them to the necessities created by particular weapons. No need I think for illustration; a thousand examples from the days of Hannibal to our own times will crowd upon your minds, and you will admit that tactical success in every age has been achieved less by creative effort than by a masterly

recognition of the value, absolute and relative, of the agencies at command.

Thus in a mechanical era, such as the present, it is in the factory, the laboratory, and the workshop, that we shall best discover the beginnings of those powers that are destined in their developments to refashion the methods of war, and control the military future.

Starting with this idea, I venture to say that the breech-loading rifle, with or without magazine, is to-day the governing tactical factor, and that the question of infantry fire is the pivot upon which the military system revolves in this year, 1890.

Infantry Tactics.

Now, the modern rifle has three leading characteristics—

1st. The rapidity of fire.

2nd. The flat trajectory.

3rd. The long range.

Of these, the first two combine to produce an overwhelming intensity of effect up to the distance at which an exact knowledge of the range is not needed, and the powers thus conferred upon infantry are well understood and fully utilized in every European army.

The third characteristic of the breech-loading rifle—its long range—has, however, as yet been turned to so little account, that it still remains a *potential* rather than an actual advantage.

I do not, of course, mean that long-range fire has no part in the musketry of to-day, but I do say that until quite lately it has occupied so subordinate a position as to be hardly worth taking into account, and that now, although its importance is about to be appreciated, its practical application seems as doubtful an experiment as ever. Yet *shooting* is not so difficult an accomplishment that soldiers cannot master it: on the contrary, remarkably good results were often recorded at long-range fire, even with the old Martini-Henry rifle, when the target was stationary and its distance actually known. In war, however, the target, as a rule, is not stationary, and its distance is not accurately known, hence it is that long-range fire has been so often ineffective, and that many of the most experienced infantry Officers persist in looking upon it as so much ammunition thrown away, except, perhaps, in the defence of a regularly prepared position.

Thus, half the power of the rifle remains, if not absolutely in abeyance, at any rate on a very different footing from the other half, and in spite of new ideas, there is an undercurrent of belief that infantry fire is only formidable at close quarters. This opinion has been distinctly embodied in the infantry tactics of the last few years, and by reflex action has greatly modified those of the other arms, especially artillery.

Has it not been tacitly admitted that infantry might approach infantry with remarkable confidence to within a certain radius, and that then, or soon after, whoever ventured to attack must be prepared to enter a veritable Gehenna, in which cohesion, and all the gradations of command would be suddenly obliterated, and through which, if

men struggled somehow, it would only be because they would feel that to turn back was certain death?

These ideas we know are already dead; they will be buried in the grave of the old big bore rifles, but what have we in their place? Certainly no solid confidence in the efficacy of long-range fire.

Here is another noticeable feature. By general consent the superiority in fire effect is always conceded to the defence, not merely when in the occupation of entrenchments, but when, as is so often the case, attack and defence alternate from side to side.

This is certainly not because the defence is likely to have more rifles or ammunition at disposal. Is it not on account of the assumed abrupt beginning of the *really* dangerous zone—that iron ring in which those who move are accounted at the absolute mercy of those who lie still or stand still?

Would this be so, if the rifle did its work steadily at all ranges? Would not the stronger side assert its superiority long before the zone of indiscriminate destruction was arrived at?

As it is, what is an infantry attack, according to popular notions, but a species of forlorn hope, to assist which no sacrifice, however great, is to be spared; for on what ground but this could artillery be urged, as it has been *ad nauseam*, to cast away its peculiar advantage—immense reach—and to thrust itself, guns and horses, into a torrent of bullets?

The demands that have been made on artillery in theory are, I think, singularly instructive, for they show two things very clearly—

1st. That infantry fire has been considered impotent at any but short ranges, otherwise how could it for one moment have been thought possible for artillery to advance into the infantry combat, seeing its horses are not bullet-proof, to say nothing of the men.

2nd. That the zone of effective infantry fire has been deemed so restricted, and its volume so immense, that the attack has been held to have no chance at all unless assisted by an overwhelming exhibition of artillery fire.

The rifle may indeed be powerful, but when put to proof in the hands of the soldier it has sometimes been found sadly incapable, and thus no two men can agree what infantry tactics ought to be.

This anomaly is, I think, traceable to one circumstance, namely, that the infantry have no means of judging distance correctly. What is called "judging distance," that is *guessing it*, is an attempt at the impossible. The average error in judging range by eye is over 30 per cent. of the distance, and no training will ever make it different for ranges over 500 yards (this I say authoritatively, for I have carried out very exhaustive experiments).

Judging distance by watching the strike of the bullets is out of the question at any but very short ranges.

Judging distance by sound has been for ever disposed of by Captain Journée's experiments at Chalons in 1888.¹

Nothing remains to be tried but mechanical range-finding, and of that I shall speak further on.

¹ Also Krupp's experiments in 1889.

Machine-guns and Quick-firing Guns.

I take it to be certain that an extensive employment of machine-guns and quick-firing guns will be a leading feature in the warfare of the future. Every year that goes by will see their mechanism simplified and their action rendered more and more automatic, till at length the wide gap between infantry and artillery will be completely bridged over by intermediate or associated arms.

Unfortunately for the reputation of machine-guns, they are as useless as rifles at unknown ranges, and their power at the present moment is equally in abeyance, except at short ranges where infantry least require help.

Tables I and II will, I think, interest you.

Table I tends to confirm what I have said as to the impotence of rifle and machine-gun fire when the range is only *guessed*, not *known*.

Table II exemplifies what can be done when the range has been accurately found.

Consider the difference between 5 per cent. of hits and 70 per cent.

Artillery Tactics.

But what about artillery? How have recent improvements in matériel affected that arm *per se*? Well! I think I may safely say that the progress in gunnery has been greater and more revolutionary even than in musketry. The B.L. field guns of to-day have a practically unlimited range; they possess telescopic sights; and they no longer fire, as in 1870, a common shell dangerous only to those close up to the burst, but can exhibit with shrapnel shell the local effects of infantry fire over almost any desired area. Nor is this all, for artillery still retains the extraordinary privilege of producing its full effect from a distance at which no fire can touch it but that of the opposing guns. Looking then to the achievements of artillery twenty years ago, in the days of its weakness, what may we not predict of it now in the maturity of its strength?

But there are at present some drawbacks in the employment of artillery which greatly narrow the field of its application. Of these the chief is its *immobility of fire*. That is the characteristic feature to which I would draw your attention. However rapid artillery may be in its evolutions, it is slow in the commencement of its fire action, and can with difficulty transfer its operation from target to target. To borrow a simile from the game of chess, it is like the rook, all powerful in its own line, but the least versatile piece on the board. This drawback peculiar to the "arm" is mainly due to the process by which (putting range-finding aside) the distance to the target can alone be ascertained.

In case any here are not fully acquainted with this process I had better describe it, but I ought to state that in consequence of the adoption of range-finding it is no longer carried out by our own artillery, except as an instructional exercise, or as an alternative should range-finding break down.

The operation of "ranging" is this:—When a battery is brought into position for action, the following routine must be followed:—

1. Estimate the distance.
2. Fire one or more rounds of common shell at an elevation nearly corresponding to that distance, and observe if the bursts are short of, or beyond the target.
3. Wherever those bursts may be, fire a group of common shell with sufficient elevation to be *certainly* beyond the target, and a similar group *certainly* short of it.
4. This done, continue the practice with common shell, gradually increasing the low elevation, and decreasing the high, until the two merge into one elevation at which the shells at length appear to burst, some correctly, some a little over, some a little short of the target.
5. Then, and only then, consider the distance determined sufficiently to proceed to shrapnel.

The expenditure of ammunition and of time involved in this "ranging" operation must depend greatly upon the merits of the first estimate of the distance;—experience, however, gives the lowest average at ten rounds, and the time at ten minutes, reckoned from the moment the gun-trails touch the ground to the opening of the first effective shrapnel shell.

Of the many inconveniences, direct and indirect, entailed by the method, the most striking is the obligation to go near enough to the target to see what becomes of the trial shots. This is not, as commonly supposed, "to observe the effects of the fire," for the telescopic sights on the guns will enable Officers to do that whenever there are any effects to observe, but it is to make sure that the guess at the distance has not been so bad as to cause the first few trial shells to drop where their bursts cannot be seen. At 4,000 yards the average error in estimating distance is fully 1,000 yards, but a shell if it bursts 1,000 yards from the target will seldom be seen at all, and if by any chance it is seen, it will probably be supposed to have come from some other battery.

This enforced shortening of the range sweeps away half the available power of modern artillery, and thus, though the guns are effective at 5,000 yards, the ranging cannot be depended upon beyond 3,000 yards, or thereabouts.

Less striking, but more serious is the disadvantage arising from the loss of time under possible fire. The time is in itself nothing, but what matters so much is the use the enemy can put it to; for from the moment a battery commences its trial shooting, it has exposed its motive, and become itself a defenceless target.

Ten minutes common shell practice is ample warning to cavalry and infantry to secure themselves, and to artillery it will sometimes be enough to bring about a very energetic reply.

In the attack of a prepared position, the advantage to the batteries of the defence will be immense. Knowing the ranges beforehand, they will often overmatch the attack before it has had time to take hold upon them. At Sedan, you will remember, two French batteries

were annihilated as they came into action without firing one effective round.

In the later stages of an action, when the artillery is called upon to assist the infantry, the disabilities imposed upon the arm by the necessity of continually repeating the ranging process assert themselves to an extent positively paralysing, and it is to this, doubtless, that we must attribute the desire to push on to those very short ranges at which a knowledge of the distance is unimportant.

Thus artillery is hampered in two ways by the difficulty of correctly judging distance:—

1st. Within the circle of its own normal action at long ranges.

2nd. When acting as auxiliary to infantry and cavalry within the zone of effective rifle fire.

As may be supposed, the rules of artillery tactics are inconsistent and represent in point of fact the contradictory opinions of two opposing schools, of which one thinks only of the capabilities of the guns, the other of the difficulties of the layers.

This is no fancy picture. If you question what I have said with regard to the embarrassments entailed by the "*ranging*" process, let me refer you to Prince Kraft, who, when he commanded artillery in 1870, had nothing better to depend upon, and fully appreciated the difficulty though possessing no remedy for it.

In his letters on artillery you will find all my statements most incisively expressed, and abundantly illustrated by anecdotes of the actual artillery fighting which took place under his own eyes.

The Tactics of Cavalry.

The tendency of the tactics of to-day is to throw an enormous amount of responsibility upon cavalry leaders.

Now success in the enterprises of cavalry unquestionably depends on their being executed in the right place and precisely at the right time. But this is exactly what is most difficult of attainment in the present day, when the fields of operation cover such extensive area, and the dangers to be reckoned with arise in such remote quarters.

What the Officer commanding a body of cavalry continually desires to know is—

1. How far he is from such and such positions.
2. How far intermediate points in his intended route are from other points of tactical importance.
3. How soon bodies of troops on either side, seen to be moving in a given direction, may be expected to arrive at particular places.

For example, suppose that, starting from some position of concealment, he believes it possible to make a favourable descent on the flank of a body advancing in a given direction. He hopes to leave cover unperceived and to cross the intervening ground at a favourable moment, as regards the enemy's infantry; but for a part of the way he will be within view of some of their batteries.

In such a case he will particularly need to consider—

1. How far he has to ride, and for how long.
2. How fast the enemy are advancing, and what distance they have to go to reach the point at which he hopes to overtake them.
3. How far away the batteries are.

If he miscalculates the distances which he and the enemy have respectively to pass over, he will inevitably arrive too soon or too late. If he makes any mistake about the distance of the batteries or the time he will be under their observation, he will run the risk of losing half his force without so much as striking a blow.

Thus an accurate knowledge of distances and rates of movement is as urgently needed for the cavalry as it is for the infantry, and yet they are now helpless in the matter, for they cannot get the information for themselves, nor can they, as a rule, afford to wait while others get it for them.

Summary.

To sum up, it appears that every arm suffers a distinct loss in its want of power to judge of distance and speed in military operations, and that in consequence, the tactics of infantry are dwarfed, those of artillery are distorted: machine-guns are wasted, and cavalry are blindfolded.

II. RANGE-FINDING. (THE REMEDY.)

General Principles.

I need hardly tell you that in my opinion range-finding is the remedy which the mechanical genius of the age offers us for the tactical difficulties it has itself created. I am well aware that some will say—why range-finding has been under trial for years and produced no effects. Gentlemen, let me assure you, range-finding has *not* been under trial for years, and is in fact only just beginning to be tried now. *Range-finders* have; but that is a very different thing. Range-finders, however perfect, no more create a working system of military range-finding than horses constitute an efficient cavalry, or rifles a trustworthy infantry. To illustrate what I mean, supposing I were asked how best to initiate such a system for any branch of the Army, I should reply:—

- 1st. Express distinctly the technical need of that branch; in other words, say exactly what you want range-finding to do.
- 2nd. Select the instruments that in their design best fulfil the required conditions.
- 3rd. Set in motion the administrative machinery necessary for an uninterrupted and sufficient supply of properly manufactured instruments.
- 4th. Set in motion the instructional machinery for an uninter-

rupted and sufficient supply of *range-takers*, that is to say, experts to work the instruments.

5th. Bring the entire organization into its proper place in the military system.

This last point I would particularly emphasize, because as long as range-finding, or indeed any other technical process, is held to be outside the every-day routine of regimental drill, so long will it be found absolutely useless on the field of battle. I suppose there is hardly any statement about war which is vouched for by a greater consensus of evidence than this—that it is a very rare thing for a man to be able to perform any duty in the excitement of action, beyond what has become second nature to him by the force of long habit. If this is true of shooting and of signalling, and of field manoeuvre, how much more so is it true of range-finding, which demands such a high degree of optical and manual dexterity?

I think it impossible to urge too strongly that range-finding is either an essential or nothing at all, and that *no* range-finding is preferable to *bad* range-finding in the proportion that no information is better than false information. Good range-finding comes by practice out of doors, not by study indoors, and if adopted at all should be accepted as the first operation in field gun drill, and the first motion of the rifle exercise.

I shall not follow up this question of a range-finding system for an army, for I have only mentioned it in order to bring out clearly the distinction between it and the mere existence of range-finding instruments. The latter will be found in endless variety in England and on the Continent. I could name from memory over a hundred designs, some good, some bad, some indifferent; but range-finding as a military system exists in the British Army only, and only in one branch of it—the horse and field artillery; moreover in that it is as yet but in its infancy, and is in consequence on a more advanced footing in batteries at home than in batteries abroad. Therefore it is evident that much remains to be done; still much has been done since 1883, when the first step was taken towards method and uniformity in this matter, and now, whatever our shortcomings may be, we are at any rate far ahead of all the other European armies, and I think likely to continue so.

The Objects of Range-finding.

Field range-finding has for its main object to place everyone on the battle-field in the position of being always at one end of a measured range with their objective at the other end. Thus the objects observed may be either *fixed*—such as houses, trees, hedge-rows, patches of ground, gunpits, and shelter-trenches; or may be movable, such as troops, of all arms, halted or marching. The ranges to be found may be very long or very short, and the time may or may not be of importance in the operation. Nor is range-finding confined to objects visible by daylight, but applies to whatever can, by any means, be seen at night. The same instruments are, however, not suitable for

every kind of work, nor are the same methods applicable on all occasions when the same instruments may be used.

Speaking generally, I divide range-finding into two classes—

1. Deliberate, for observation of fixed objects at all ranges.
2. Instantaneous or semi-instantaneous, for stationary or moving objects at the shorter ranges.

As a good example of deliberate range-finding, I will give you a short *résumé* of what can be done by means of our service artillery instruments; and, as a fair specimen of instantaneous range-finding, I will describe certain results recently obtained at Aldershot, using our old service infantry instruments. These instances, I think, will be enough to convince you of what range-finding *can* do, so that I shall not need to refer in any way to range-finders in military use on the Continent, nor to those now under trial in this country.

I am very anxious to confine my remarks to range-finding as distinct from the subject of range-finding instruments, which, though a very important one, is foreign to what I am submitting for discussion to-day.

The Service Field Artillery Range-finding.

The system of range-finding introduced some years ago into the drill of the Royal Artillery, Horse and Field, and which is still our regulation system, is limited to the observation of stationary objects by daylight. The point of observation may be either in the target itself or in something noticeable near to it.

One man performs the whole of the optical work; but he is helped by an assistant, who is qualified to take his place, if need be.

Great accuracy at long ranges is the chief desideratum; this is, however, limited by certain restrictions which apply to all instruments carried by mounted men, and required to be used under service conditions.

Extreme importance has never been attached to the element of time, because it is not intended that the range-finding should, as a rule, be performed when either the batteries or the range-takers are under fire.

For the first artillery positions, the range-finding should be completed while the batteries are still in column on the roads or assembling preparatory to taking up their ground.

For later stages of the action, it is provided that whenever a move becomes necessary the range-takers should ride in advance, accompanied by an Officer, to select the new positions, and so have the ranges all ready for the guns as they come up; this duty being performed *under cover*—that is to say, in such a way that the advanced parties may not be seen by the enemy constituting the new target, or posted near to it.

Range-finding is, of course, unnecessary for artillery in action against large targets at very short distances.

The *range-takers* of batteries at home have recently been all trained in the School of Range-finding, and have passed an examination

which ensures that they can work to an average error not exceeding 2 per cent. (20 yards per thousand), up to a range of 5,000 yards; always provided the object can be distinctly seen by the naked eye, or in the small telescopes belonging to the instruments.

Table III shows the accuracy at the final examinations of the last six classes of non-commissioned officers who obtained certificates at the School of Range-finding.

Tables IV and V show what the artillery range-takers have done at the annual competitions of the Army Rifle Meeting. Table IV is work done with instruments supplied by the Committee, the competitors on foot from first to last.

Table V is the work done at the mounted competitions (of which we have only had two), the competitors being in teams representing a full range-finding party, and bringing their own horses and their own battery instruments and equipment.

Table VI shows the accuracy kept up by the battery range-takers, taking the average of twelve service batteries.

Here you will notice a falling off as compared with the results at examinations and competitions, which may be attributed to two causes:—

1st. The targets at the practice consisted of yellow wooden dummies seen against a brown ground, and were, some of them, only visible through the powerful telescopic sights now fitted to the guns.

2nd. The ranges were not ascertained absolutely; those by range-finder being merely compared with those by gun; so that if there was any variation of the ammunition from the standard strength, or any faults in the laying, the entire discrepancy would be debited to the range-finding.

For example, take an imaginary instance. Say that on a particular occasion the exact distance was 3,000 yards, and that the range-finder made it 2,970, this would be an error of 1 per cent.; but if the powder was a little under normal strength it might be necessary, in order to hit the target, to elevate the guns till the tangent-scales read 3,090 yards: and then in the report of such practice the true range would be given as 3,090 yards, and the error of the range-finding would be set down as 100 yards; that is to say, 4 per cent.

Putting this, however, aside, and granting that the difference between guns and range-finding at last year's practice was (as it may have been) all due to errors in the range-finding, I would still point with a certain satisfaction to the net results. For, supposing that those 120 ranges had represented the range-finding of 120 batteries—which I will call A—come simultaneously into action against 120 other batteries—which I will call B—and which had no means of ascertaining their ranges, except the ranging process; and supposing, for the sake of the argument, that the A batteries had accepted their own range-finding as perfect, and not fired so much as one verifying shell; let us see how the two sides in the duel would have stood at the end of the ten minutes allowed to the B batteries for ranging.

A Batteries.. All intact.
 B Batteries $\left\{ \begin{array}{l} 38 \text{ completely silenced.} \\ 54 \text{ severe losses.} \\ 28 \text{ intact.} \end{array} \right.$

In the following ten minutes the twenty-eight B batteries opposed to the twenty-eight A batteries, whose error of range exceeded 100 yards, would obtain an advantage, but not to the extent of silencing them all—because it is reasonable to suppose that some at least of these A batteries would have discovered their mistake early in the first ten minutes.¹

The foregoing is, of course, a purely theoretical comparison—no such duel being possible—but it serves to illustrate my point, which is that range-finding with an average error of even 4 per cent. is immensely better than the ranging process untempered by range-finding.

But you may, perhaps, question my estimate of the effects of ten minutes' fire of one battery upon another. Here is an example from actual practice to show I am not far wrong. Last year a battery of four guns, after verifying its range, fired twenty-four shrapnel shell at a target representing six guns and the gun numbers, range 2,650 yards. Time occupied—about five minutes. The effect was one gun disabled; rather more than half the men hit.

From this you can judge of what might happen if six guns fired at six guns—not for five but for ten minutes.

The tables I have referred you to, give some idea of the time required for range-finding. As already remarked, this must not be regarded as time under fire, still it may sometimes be of much importance. Now nothing is more difficult than to say exactly how long to allow for finding any given range, so much depends on local circumstances; but when working on open ground, with no difficulty as to cover or light, the time may, as a rule, be reckoned to be two minutes for 1,000 yards, three for 2,000, and so on, adding a minute for every 1,000 yards. This does not, however, include the time occupied in choosing the position for the battery or in selecting the target or pointing it out to the range-takers, nor does it allow for a second observation, whereas there are many cases in which a repetition of the work (by a second range-taker if possible) is most desirable. On the whole, therefore, it is useless to pretend that our artillery range-finding is a rapid process. All we may say is, that it takes no longer than *ranging* without instruments, and that it draws no fire and wastes no ammunition.

¹ The comparison at the end of twenty minutes might, therefore, be assumed to be—

A Batteries $\left\{ \begin{array}{l} 14 \text{ silenced} \\ 14 \text{ severe losses} \\ 54 \text{ slight losses.} \\ 38 \text{ intact.} \end{array} \right\} 28.$
 B Batteries $\left\{ \begin{array}{l} 92 \text{ silenced } (38 + 54). \\ 14 \text{ slight losses} \\ 14 \text{ intact} \end{array} \right\} 28.$

Application of Range-finding.

I have said that the aims of the service artillery system of range-finding are very limited, still by means of that system a good deal can be done, because, besides enabling ranges to be measured from the ground occupied by the range-takers, it provides a simple means of finding how far points viewed from the battery are distant one from another. The Officer commanding having first got the ranges he immediately requires, can set his range-takers to find the ranges he will probably need later on from his present position, and from the ground he expects to take up at his first advance. Such information, if transferred to a rough sketch drawn without instruments, will be found far more valuable than the most elaborate map, because it will show what is needed for the occasion, and nothing more, viz. :—

1. Distance from guns to enemy's positions.
2. Approximate frontage of enemy's position.
3. Distance of enemy's positions from each other.
4. Approximate distance of (probable) next position of battery from enemy's positions.

For fuller account of this class of reconnaissance let me refer you to Lieutenant Buckle's lecture on Range-finding, Aldershot Military Society, May, 1889.

Recent Advances in Range-finding—Novel Methods.

Having gone at some length into what can be done by our authorized drills, I will now briefly tell you what we can do over and above this with the same instruments, by methods which do not form part of the compulsory course for range-takers, but which represent no small part of the work of the School of Range-finding during the last two years.

Fixed Lights.—Night Marches.

1. The range can be found of any stationary light seen at night. Not only can camps and bivouacs be brought by this means under fire at night, but night marches of moderate extent can be exactly regulated. All that is necessary is to base the orders for the march on a reference to one or more fixed lights, and to supply each independent body of troops with a map and a prismatic compass, in addition to the range-finding equipment, which for this purpose includes a dark lantern.

Then, whenever the question is asked, "Where are we now?" the range to, and the bearing of, the light is noted. Reference to the map then at once identifies the spot of ground arrived at.

Moving Objects.

In 1888 it was necessary, for some experimental practice, to devise a method for finding the range of a captive balloon in motion.

This was a most fortunate occurrence, for not only did we succeed in doing this, but found out a way of finding the range of other moving objects with fair accuracy and considerable rapidity.

The ranges of the balloon were easily recorded twice a minute, with an average error of less than ± 3 per cent., and the balloon, in consequence, was quickly brought to the ground by the fire of a single 12-pr. gun at 4,000 yards range.

All last summer the range-finding classes were constantly exercised in the observation of balloons and of troops in movement, and no difficulty was experienced. The method, however, needs a few minutes' preparation, and the range-finding equipment of two batteries is necessary.

Intermittent Lights (Limelights and Electric Lights).

The ranges of these have also been taken without difficulty, by combining the range-finding of two batteries.

The Field Telemeter.

Here it may be asked why we have not hastened to graft these new methods on the regulation drill of the artillery range-takers. The reason is this:—Some time before these were even thought of, a new ranger-finder was tried and approved for future supply to the field artillery, and now we are just about to get that supply.

The new instrument, which is called the *field telemeter*, is very much superior to the field range-finder, as an instrument for the observation of stationary objects, and it particularly facilitates range-finding under cover, a very necessary but hitherto rather difficult operation.

The introduction of the telemeter is therefore a great step in advance, but it remains to be seen whether we can satisfactorily do all those extra things with the new instrument, which we have lately seen our way to, with the field range-finder.

If we can, well and good—if not, there are other very simple and portable instruments for semi-instantaneous range-finding, which can, if necessary, be added to the artillery equipment.

Instantaneous Range-finding for Infantry.

There is at this moment no complete range-finding system for infantry, but range-finders are very generally used by Officers as auxiliary instruments. In our Army, there are two distinct service patterns, and every regiment of cavalry and battalion of infantry is allowed a set of either of these as part of its fighting equipment, and a second set of the same pattern for instruction.

The School of Range-finding exists however for artillery only, and there are no trained observers in the cavalry or infantry corresponding to the artillery range-takers.

For this reason partly, and partly because the instruments have

been applied in the service only to the observation of stationary objects, range-finding has as yet no real footing outside the artillery. But there are indications of a great change consequent on the introduction of the new rifle, and the expectation of smokeless powder. Already, as you probably know, the subject has been taken up officially, and we expect very soon to have a new pattern infantry range-finder especially suitable for the instantaneous observation of moving objects. Whatever we do get, one thing is pretty certain, it will be superior to anything we have got *now*, and this will, I hope, lend some interest to what I am going to say about an expedient for instantaneous range-finding by means of the service instruments.

Application of Service Infantry Range-finders to Observation of Moving Objects.

In 1886 we set ourselves to ascertain if it was possible to adapt the service infantry range-finders to the fire tactics of infantry, that is to say:—

(1.) To obtain ranges quickly enough to satisfy the needs of the firing line, not delaying the advance or masking the fire.

(2.) To ensure sufficient accuracy at all ranges to prevent waste of ammunition.

(3.) To predict the range of troops in rapid movement in time to allow for words of command, deliberate aim, &c., and secure a succession of effective volleys upon them.

After many experiments it was found practicable—

1st. To simplify the service Watkin equipment by dispensing with the use of pickets.

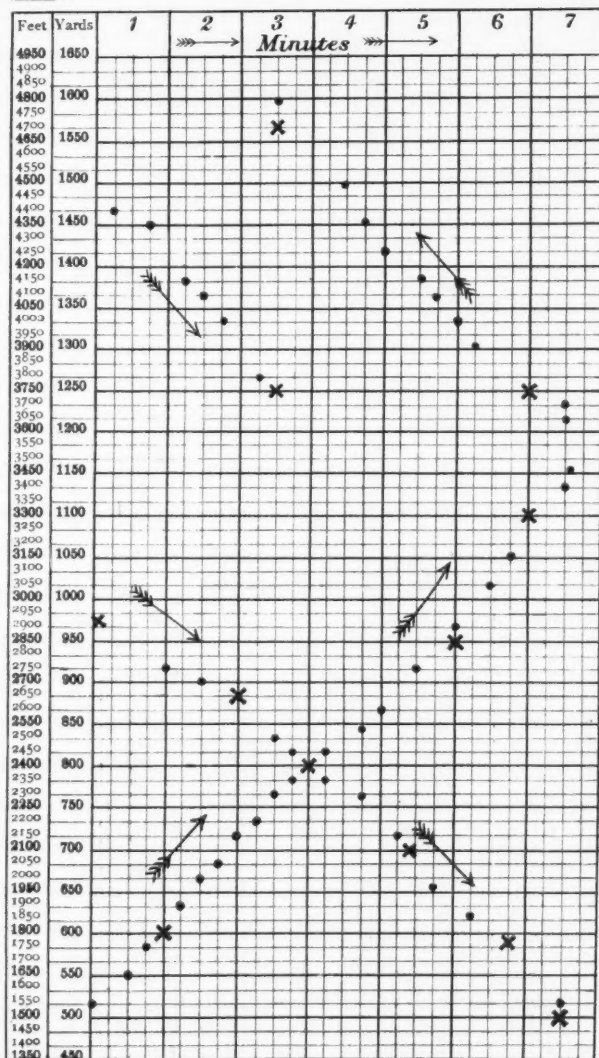
2nd. By a certain combination, to get a succession of readings of the ranges of any body of troops in movement up to 1,600 yards.

3rd. To record such successive readings in a way which *averaged* them *without need for calculation*, and eliminated the worst errors, while at the same time it determined by diagram the rate of approach or retirement of any body of troops under observation, so as to permit of *predicted firing* for rifles or machine-guns.

This method was accorded an extended trial at Aldershot in 1888-89, with very satisfactory results. For example, on the very first day, out of eight volleys at infantry moving in attack formation from 1,700 yards to 350 yards, one volley only was judged to be ineffective. In the remaining seven from 350 to 1,200 yards, the greatest error made was 30 yards.

On another occasion out of 22 volleys (5 at cavalry trotting) 17 were judged to be fully effective, 3 partially effective, and 2 only wasted.

The way the accuracy was tested was this; a party of infantry accompanied the range-takers and at intervals fired blank volleys in accordance with the range-finding. At every volley the moving party acting as target left a marker to show the exact spot occupied at the moment each volley was fired, and the true distances were afterwards chained and compared with the ranges given in the words of command.



REFERENCE.

THE VERTICAL LINES DENOTE TIME; THICK LINES THE MINUTES; THIN LINES THE QUARTER MINUTES.

THE HORIZONTAL LINES DENOTE RANGES; THICK LINES THE EVEN 50 YARDS; THIN LINES THE INTERMEDIATE POINTS.

THE DOTS ARE RECORDS OF READINGS OF THE RANGE TAKEN.
THE GROSSES ARE THE PREDICTED VOLLEYS.

THIS DIAGRAM IS $\frac{1}{2}$ LARGER THAN THE CARD.

HARRISON & SONS LITH. 57 MARTIN LANE, A.C.

In applying this system it is found that the range-takers (of whom there should be several in every company) can carry their range-finding equipment in addition to their rifles, and keep up with the rest of the company, always ready to find the range of any opposing troops. When a knowledge of the range is no longer needed, that is when the fixed sight can be used, the range-takers take up their rifles and fall in.

The system I have mentioned has been provisionally adopted, but the particular range-finding contrivance (if I may so call it) is not likely to survive the introduction of new pattern instruments, and is therefore of little importance. The method of recording by diagram and of predicted fire is however applicable to all range-finding, and will probably be retained for service, and certainly for instruction and exercise.

Table VII shows a set of consecutive observations of range made by three infantry Officers under my supervision a short time ago. Each Officer in turn commanded, that is to say, recorded the readings and gave the words of command to the firing party, while the other two did the range-finding.

You will observe that only four of the fifty volleys would have been entirely thrown away, and that the moving party (or target) was kept under continuous observation.

The reason why there were such long intervals between the volleys was, that it was undesirable to expend too much ammunition, and that it was necessary to verify *each* volley by independent observations to the last marker dropped by the moving party. The breaks which you will notice here and there either occurred when the marching party were hidden by folds of the ground or when the Officers were changing rounds.

The accompanying diagram is a *facsimile* of the range-finding card used by one of the Officers on that occasion. This particular card was designed to record ranges taken in *feet* and to convert them into *yards*.

The mode of working was as follows:—The Officer who commanded stood with the card and his watch in hand. The range-takers were within easy hearing of him, and the firing party immediately in front, or in line with them.

The Officer called for readings at such intervals of time as suited him, and marked them on the card by dots. After every two or three consistent readings he made his prediction, and gave the word of command "*At so many yards.*" Most of the predictions were made half a minute ahead to allow for aim and time of flight—this latter being represented by the time it took for the marching party to hear the volley and drop a marker.

This system adapts itself easily to any approved distribution of men for fire discipline. For instance, the Captain may command the fire of his entire company, or delegate the ordering of the volleys to half-company or section leaders; but whoever names the range at which any volley is to be fired must have range-takers at his disposal. Thus the smaller the fire unit is made the greater must be the number of instruments and trained range-takers.

This condition is inevitable, and can hardly be deemed prohibitive considering the absolute necessity of knowing the distance if the volley is to be effective. It is surely better to incur some expense, and to spare a few rifles for the time being from the firing line, than to work in the dark and waste ammunition.

No delay occurs on a sudden order to advance. The range-takers can either fall in at once, or keep close to the Officer during the movement.

And now I hope I have succeeded in convincing you that we have already solved the problem of how troops are to estimate distance and time on the field of battle; and I ask you to admit that as we can do so much already with the materials at hand, we are likely to do much more in the future, when both instruments and methods have been improved, as there is every reason to suppose they will be.

I only wish that instead of describing these things within four walls, I could have the privilege of demonstrating to you in the open country, at Aldershot or elsewhere, with what ease everything I have spoken of can be done. Believe me, it is only a matter of careful training and constant practice. The day will come, I am confident, when range-finding will go hand-in-hand with musketry as well as with gunnery, and when the weekly routine of an infantry company will include at least one parade in which the range-takers are exercised upon moving objects. When that day arrives we shall seldom hear of stationary targets at the rifle ranges, and there will be no more any broad distinction made between target practice and service practice, or between the musketry for rifle matches and the musketry for active service.

III. THE EFFECT OF RANGE-FINDING UPON TACTICS. (THE RESULTS.)

Coming to the subject of the effect of range-finding upon tactics, which you will I hope fully discuss, I must frankly disclaim all pretension to rank as a prophet. I shall in fact venture no more than to point out some of the immediate consequences of range-finding, and then with much diffidence record my own humble opinion as to the direction in which we shall be gradually led by the adaptation of tactics to these novel conditions.

Immediate Effects of Range-finding in the Infantry.

To commence as before with infantry, the very first effect of the establishment of a working system of range-finding will be a marked increase of confidence in the rifle, which will react with beneficial effect upon the minds of the men. Marksmanship will be an accomplishment more highly prized than it has ever yet been, because collective skill will once again be able to overcome the mere power of numbers.

Good and true soldiers, strong nerved and clear sighted, will no longer be discouraged by the thought that in the decisive musketry struggle they can count for no more than an equal number of the

feeblest rattle. An infantry combat will be no more as when desperadoes shoot blindfold across a 6-foot table, but will resemble a scientific duel in which two well-skilled antagonists take their careful aim across the wide and well-paced interval.

And of all nations we English will most benefit by the change, for though our numbers are small our personnel is splendid. Have we not among us the best shots in the whole world? Are we not the descendants of those invincible archers before whom all the chivalry of France was as nothing?

The certainty of a knowledge of the range at all times will make it worth while to be able to profit by that knowledge, and there will thus be a two-fold improvement, which will enormously extend the zone of reliable fire. One result of this extension will be that the region of maximum intensity will be approached by such a gentle gradient that there will no longer be any sharply defined area of extraordinary danger, although in itself the fire at close quarters will become more effective than ever, because the range-finding will tell exactly at what moment rapid fire should begin.

Concurrently with these changes there will probably be a distinct economy of ammunition, for it will have a most sobering effect on the soldier to be accustomed invariably to wait for a word of command, which again he knows depends upon a reference to the records of instrumental observation. Great steadiness, too, will follow the habit of delivering volleys at regular intervals of time against moving targets, for afterwards when in action the men will always feel sure that the enemy's rate of approach is well gauged, and will know for certain that as long as the range-takers continue at work nothing exceptional is likely to occur. By degrees they will acquire the habit of estimating *pace* in *minutes*, and converting those minutes into the corresponding number of deliberate volleys which separate them from the enemy, and this will go far to neutralize the effect which the sight of cavalry and artillery advancing at a gallop might otherwise have upon them.

As regards infantry then we may say that in consequence of range-finding—

1. The shooting power of the men will be brought up to the level of the capabilities of the rifle.
2. Rapid fire will never be thrown away.
3. Continuous fire will be maintained on moving objects.
4. Ammunition will be economized.
5. Musketry instruction encouraged.
6. Confidence re-established.

And it is worth notice that the introduction of smokeless powder will favour these tendencies, and go far to eliminate all remaining elements of chance.

Effects of Range-finding upon Artillery.

Assuming that artillery will eventually possess, in addition to its means of deliberate range-finding, some method of instantaneous

observation of troops in movement, it will then enjoy the advantage of its full range, and also be able to operate in the infantry combat without any great sacrifice of either men or horses.

It may, it is true, suffer some inconvenience from variation in the strength of its ammunition when the target is very small, but means will no doubt be forthcoming for disposing of the difficulty.

Machine-guns and Quick-firing Guns.

Range-finding will do more for this class of weapon than for any other. By its aid machine-guns will probably become a separate arm, and will at all events fulfil an entirely new and more or less independent rôle.

Tactics of the Future.

The tactical changes which I think may follow the acquirement of the new powers I have indicated are as follows :—

1. Extensions from column of route will have to be made at far greater distances from the point of attack than is now necessary. This on account of the increased effective range of artillery.

2. The artillery duel will commence at the extreme range of the guns unless the nature of the country admits of an advance under cover.

3. No general advance will be possible until the artillery duel has been decided, because—

4. Artillery will be much more formidable to infantry and cavalry at long ranges than it has ever been before.

5. The side which succumbs in the artillery duel will be unable to undertake the offensive except in counter-attack.

6. Machine-guns will probably act in battery.

7. Those of the defence will delay the advance of the attacking infantry, and—

8. It will be necessary to crush them by artillery fire.

9. Machine-guns will, however, generally silence field artillery within their own zone of effective fire.

10. In all infantry attacks machine-guns will assist, and will be particularly directed against batteries unmasked at machine-gun ranges.

11. Artillery will still continue to support the attack effectively, though it will rarely need to advance to infantry ranges.

12. Frontal attacks on prepared positions will be rarely possible, and flank movements will have to be carried out on the arcs of very great circles.

An infantry attack, however, when it is made, will be a far more deliberate operation than is dreamt of now. The zone of fire will be entered so gradually that at no instant will the risks seem more than they were the moment before, and thus men will accommodate themselves to the changes during the very progress of the action. At a certain distance, according to whatever the powers of the rifle may be,

casualties will begin and will increase by slow degrees, the losses being felt on both sides. Then will take place a progressive struggle for mastery, which will be fought out at gradually decreasing ranges until one side or the other begins to get the upper hand. From that time forward the proportionate loss will be greater on the losing side, and the magnitude of that loss will go far to mitigate the severity of the fire which the other side will have to encounter at what are at present considered the decisive ranges. It will, therefore, often happen that the defence will rapidly fall off just when its maximum strength is looked for, and the final attack will be carried against a decimated and broken-hearted remnant already bent on retreat.

As regards formations of infantry I hardly like to hazard a conjecture; but I cannot but think that the chief object in future will be a maximum delivery of effective fire, and that the tendency will be towards the old English method of getting breadth without depth; a compact, not an open fighting line, fed by supports in extended order at distances so adjusted to the range of the opposing fire as to ensure a minimum sacrifice.

13. Some important *general* results may also be expected; for example:—

- (i.) Balloon reconnaissance will be found more than ever necessary, but it will be a far more difficult and dangerous duty to carry out than it is now assumed to be.
- (ii.) Night marches will be more frequent, especially marches to secure positions for the next morning's operations.
- (iii.) Electric search lights will draw artillery fire, and so will signal lights.
- (iv.) Camps will be unsafe at night if any fires or lights are to be seen.

This completes a rather long catalogue of points for consideration, which I cannot pretend to have done more than indicate.

In conclusion, I may add that I know I am liable to be told that my ideas are unorthodox, according to the standards of 1870, and that with respect to the value I put upon range-finding, foreign military opinion is against me from first to last.

To this I can only reply that Progress has ever defied Prescription, and that as to foreign opinion, what passes for it in England is often spurious and generally obsolete.

The Germans are on the point of abandoning their entire system of battle tactics in consequence of the introduction of their new rifle. Will they not quickly accept the only means possible of properly focussing the long-range fire upon which they now propose to depend in attack as well as defence? Shall we in England adhere blindly to precedents already discarded by those who created them? The harvest of 1870 was indeed bountiful; but may we not perhaps glean too closely in the fields from which the reapers have so long departed?

TABLE I.—*Example of Volley Firing at Aldershot with Range judged by Eye and corrected by Observation of the Effects of the Fire.*

Fire from.	Target.	No. of rounds fired.	Range yards.	Hits per hundred of shots fired.
30 Magazine rifles ..	Column, 60 feet wide, 60 feet deep Line of 3 feet, dummies, no depth	About 150	1,500	Nil.
M.H. rifles		About 400	540	5½

TABLE II.—*Example of Volley Firing at Aldershot with Range known beforehand or ascertained correctly by Range-finder.*

Fire from.	Target.	No. of rounds fired.	Range yards.	Hits per hundred of shots fired.
30 Magazine rifles ..	Column, 60 feet wide, 60 feet deep	150	2,000	18
" ..	Ditto.	"	1,500	69
" ..	Line 6 feet, dummies, 16 feet wide, no depth	"	800	64
Nordenfelt gun .. { Magazine rifles .. {	Column, 70 feet wide, 60 feet deep	50 from gun, 24 from rifles	1,340	83
Nordenfelt gun .. { Magazine rifles .. { M.H. rifles	Line 6 feet, 140 feet wide, no depth	130 from gun, 72 Magazine rifles, 39 M.H. rifles		
			980	26

TABLE III.—*Accuracy at the Examinations of the Last Six Classes of Non-Commissioned Officers at the School of Range-finding, Aldershot.*

Percentage of error.						
<i>Four ranges are given at each examination.</i>						
	Up to 1,000 yards.	Between 1,000 and 2,000 yards.	Between 2,000 and 3,000 yards.	Between 3,000 and 4,000 yards.	Between 4,000 and 6,000 yards.	Time under instruc- tion.
1	2.5	1.2	0.7	1.0	..	About eight weeks.
2	1.0	2.7	..	1.3	1.1	
3	1.1	..	1.3	2.7	1.1	
4	0.9	0.8	1.8	..	1.2	
5	1.9	1.0	1.0	..	1.8	
6	1.4	0.5	1.2	..	2.0	
General average }	1.4	1.2	1.2	1.7	1.4	

Total average error of all ranges up to 6,000 yards, 1.3.

TABLE IV.—*Accuracy at Competitions.*

	Prizes.	Reading in yards.	Time. ms. secs.	Error in yards.	Error per cent.	Average error per cent.

*Army Rifle Meeting, 1887.**Medium Range Competition.*

Five prizes given.
Object—clump of gorse.
True distance 2945 yards.

{	1	2925	2 27	20	0.67	1.25
	2	2925	3 25	20	0.67	
	3	2915	2 48	30	1.01	
	4	2900	2 55	45	1.52	
	5	2875	3 12	70	2.37	

Long Range Competition.

One prize given.
Object—stone building.
True distance 6375 yards.

{	1	6440	3 50	65	1.01	

TABLE IV.—*continued.*

	Prizes.	Reading in yards.	Time. ms. secs.	Error in yards.	Error per cent.	Average error per cent.
<i>Army Rifle Meeting, 1888.</i>						
<i>Medium Range Competition.</i>						
Two prizes given.	}	1 2975	1 52	4	0 13	0·4
Object—tree.		2 2950	2 5	21	0·70	
True distance 2971 yards.						
<i>Long Range Competition.</i>						
Two prizes given.	}	1 5550	2 50	10	0·18	1·5
Object—building.		2 5700	5 0	160	2·80	
True distance 5540 yards. (Light very bad.)						
<i>Army Rifle Meeting, 1889.</i>						
<i>Aggregate Accuracy in Two Ranges.</i>					Aggregate error per cent.	
Two prizes given.	}	1 { 2122 }	Under 10 minutes.		0·80	0·8
Objects—tree, tent.		2 { 4436 }			0·85	
True distances 2145, 4460 yards.						

TABLE V.—*Accuracy at Competitions.*

Mounted Match. Army Rifle Meeting, 1888.

Conditions.— $\frac{1}{4}$ mile, over two fences, find one range and mount again.

Time from start to finish to be under seven minutes.

Eight teams entered; two disqualified for time.

Score.—Object: Engineer cart; chained 1,618 yards.

Prize.	Readings.	Time.	
		ms. secs.	
1	1,615	6 51	} Average error $\frac{4}{10}$ per cent.
2	1,630	3 54	

Average error of remaining teams, $1\frac{2}{10}$ per cent.

Mounted Match. Army Rifle Meeting, 1889.

Conditions.— $\frac{1}{4}$ mile, over two fences, find two ranges, and mount again. Aggregate time from start to finish to be under eight minutes.

Nine teams entered; one disqualified for time.

Score.—Objects: Engineer wagon; chained 1,046 yards.
Tree 1,920 „

Prize.	Readings in yards.		Time.		
			ms.	secs.	
1	1,040	1,920	7	9	} Average error $\frac{9}{10}$ per cent.
2	1,054	1,940	6	50	

Average error of remaining teams, about 2 per cent. (exact score not preserved).

TABLE VI.—*Accuracy of the Range-finding at Annual Practice, Okehampton, 1889.*

Difference between the ranges as formed by the range-finding and as verified by common shell practice:—

Number of batteries at practice	12
Length of ranges up to	5,000 yards.
Number of ranges found.	120
Average difference per cent. of range. .	4.06

Analysis of the Differences.

Less than 50 yards.	64 instances.
Between 50 and 100 yards ..	28 „
More than 100 yards	28 „
Total.	120 „

TABLE VII.—*Particulars of Fifty Predicted Volleys. Target—A Party of Infantry marching. Pace—Quick.*

Volleys judged to be totally ineffective are in bold type.

Volleys. yards.	True range. yards.	Error. yards.	Volleys. yards.	True range. yards.	Error. yards.
860	820	40	1,500	1,550	50
980	900	80	1,200	1,180	20
1,105	1,150	45	1,000	1,030	30
1,240	1,200	40	800	800	0
550	543	7	700	710	10
650	700	50	550	550	0
750	750	0			
875	880	5	600	640	40
1,000	1,000	0	800	820	20
1,150	1,150	0	950	990	40
1,350	1,310	40	1,100	1,100	0
			1,250	1,245	5
1,300	1,370	70	1,575	1,590	15
1,175	1,160	15	1,250	1,205	45
850	870	20	980	1,000	20
750	770	20	880	910	30
650	620	30	700	695	5
550	550	0	580	545	35
			500	475	25
1,480	1,500	20	700	707	7
1,740	1,605	135	950	878	28
1,350	1,365	15	1,050	1,050	0
1,200	1,220	20	1,350	1,250	100
1,000	960	40	800	822	22
800	820	20	600	598	2
700	720	20			
620	620	0			
550	500	50			

See Diagram.

General P. SMITH: There is just one thing I should like to point out with reference to this very interesting and instructive paper. The rifles of the present day have an enormous range, but it is evident that the mere possession of a rifle that will carry 2,500 yards is not sufficient for the soldier, unless he has always a means of finding out the actual distance of the object at which he is firing. I therefore think it is absolutely impossible that we should go on without having proper instruments by which to ascertain the ranges of the men or horses whom it is desired to hit. This question of range-finding is not a new one, because for the last thirty-five years it has constituted part of the drill of the Army, so that the fact of the necessity of range-finding has been thoroughly admitted. I am very anxious about this matter of accurate range-finding, because, while it will conduce very largely to the use of the rifle, I believe it will also have an extremely good effect on the men, because when men feel that there is a possibility of getting an accurate range, they will wait till they get it, and their fire will therefore be very much more under control than it is now. Discipline is, of course, at the root of everything, and therefore, as it assists discipline, I consider the subject a most important one. I hope that possibly in the course of time we shall see a school of range-finding for

infantry established in the same way that we have a school of range-finding for artillery, so that a certain number of Officers from each battalion may be trained to go out with the range-finder and to take ranges on any objects which are desired.

Lieutenant-Colonel F. SALMOND: Lord Wolseley and Gentlemen,—As an Officer who has had considerable experience both in range-finding and musketry, I beg to add my mite to the discussion of this very important subject. To begin, I must add my testimony to what is now generally acknowledged, namely, that beyond 500 yards, up to which distance the "fixed" or lowest sight of the new rifle enables us to dispense with accurate judging distance by the eye, it is absolutely necessary to have the distance measured by means of the best obtainable instrument, worked by very highly trained men. Now, if we take the comparatively short range of 800 yards, and a target representing a line of infantry on the march or at the halt, we cannot hit it (except by a few stray shots) unless the elevation we use is within 35 yards of the correct distance—the bullets will go either under or over it. No judging by eye is possible within such limits. As the distance increases the margin becomes still smaller, until at about 1,000 yards, even when the correct distance is known, it is a question whether it is worth while to fire at a line having little or no depth. Here, then, we reach a zone from which targets having depth, such as columns, or positions crowded with troops, or troops defiling, should, as a rule, alone be fired at; and from thence, let me assure you, by far the heaviest losses can be inflicted, simply by reason of the depth of the objective, always provided that the firing lines are well trained, and well commanded by skilled Officers and sergeants who direct the shooting. It may be said that the enemy will not show themselves in such good targets, but there are many occasions when they *must* do so; for example, when the ground over which they are manœuvring is confined, or broken up by streams, woods, marshes, &c., or when the enemy is in numbers too great for the ground to permit of their adopting the least vulnerable formations. Now, believe me, if we have proper range-finding and proper control and direction of fire, it is easier to inflict losses at long than at short ranges; therefore we must study long-range fire, so as to make it as effective as possible. And now I am about to say something which many Officers may be startled to hear; it is this—that at long ranges it is not enough to know the distance, though it may be within a yard or two of the correct one; we must also know what addition or deduction, due to local conditions of air pressure and wind, must be made to or from the range given by the range-finder, which we may assume to be exact. Those deductions or additions are sometimes enormous at such ranges as 1,500 and 2,000 yards. For instance, when directing firing at an ascertained range of about 1,650 yards I have more than once observed a difference of from 150 to 200 yards of *extra* elevation, due alone to a strong head wind. To give you another example, I have seen volley firing at 800 yards at a target 4 feet high by 16 feet wide, representing men in the kneeling position. The local conditions were that the wind was light from the rear, but the day was very cold and dry, denoting increased air pressure. There was an increased elevation required of 20 yards. Firing without that elevation, the bullets struck the ground short and ricocheted over the target. Here, then, an error of only 20 yards was sufficient to cause the fire to be ineffective. I could produce many other examples, but these are enough to show that we must have not only accurate range-finding, but also Officers and sergeants who can judge at a glance what should be put on or taken off from the ranges given out by the range-takers.

Captain CRAFTED, Grenadier Guards: In touching on the subject of range-finding as applied to the infantry attack, Colonel White suggested that each company should be followed by several range-takers, who would move close behind the firing line and take the ranges from time to time as required. I cannot help thinking that it is doubtful whether such a system would be found practicable on service, because these men following close behind the firing line would be in the thick of the fire, in the thick of the confusion, and not exactly in a mental state to take an accurate observation requiring a great deal of coolness and care. I think, therefore, it is worth considering whether a system could not be adopted which would give each battalion one very well trained range-finding party in charge of an Officer. This party, whether in attack or defence, would take up a good position, either on the flank

or in the rear of the firing line, but well clear of it, from whence it could take accurate observations, and from whence it could signal the result of these observations to the fighting line of the battalion. In order that these signals should reach the Captains of companies immediately, it would be necessary that each Captain should tell off a man, whose sole duty would be to watch for the signals and at once communicate them to the Captain. I do not see why a system of this kind should not work well. Any one who has been engaged in field firing must, I think, feel convinced that there is a need of some well laid down system for range-finding which will allow of the range-finding party being placed well clear of the firing line and away from its unavoidable din and confusion.

Major BARRINGTON FOOTE, R.A. : My Lord and Gentlemen,—The lecturer made use of the following words : " Gentlemen, let me assure you that range-finding has not been under trial for years, and is, in fact, only just beginning to be tried now. Range-finders have ; but that is a very different thing." This, from my experience, at all events in my branch of the Service, is almost absolutely true. For some years it was looked upon as something which had to be done ; it received but scant encouragement, and elicited but little interest. This I attribute to the fact that there was no glamour or effect about it at an inspection, or on parade. Fat horses, jingling collar chains, a brilliant gallop of seventy yards, a sudden halt, a string hastily pulled, a puff of smoke almost at the time that the trail of the gun touches the ground, will cause a thrill of admiration to pass through the assembled spectators ; but three men quietly putting pickets into the ground and looking through a small box appears as dull and unexciting as the looking over a gun to see if it be laid correctly. We have every confidence in the instruments—they are all right ; but it is only comparatively lately that we have grasped the fact that we want special men specially trained so as to become experts. To make all non-commissioned officers take ranges is worse than useless ; they would not have time to learn, and keep up rapidity and accuracy. It is of importance that we should have a few men, so perfect, that we may have absolute confidence in them. The two points for my branch of the Service to think of are, ability to arrive rapidly at a certain point, and then to be able to hit when you get there. You cannot hit unless you have the range, and, therefore, in my humble opinion, it would be next to madness not to welcome and give every possible encouragement to what I think would prove to be a most valuable help, if not on all, yet on many occasions.

Colonel F. CARDEW : The advantages of a range-finder for artillery are, I think, unquestionable ; whether range-finders are a necessity for cavalry may perhaps be better left to any Officers of that arm who may be present to discuss the question, but I venture to think that, besides knowing the distance between the cavalry and the object it is going to attack, there are the conditions of the country which intervene, such as enclosures, marshes, &c., and the necessity of possibly making détours to avoid fire, &c., which have to be considered, and these considerations would appear to neutralize the advantages claimed by the lecturer for the range-finder. There is not a doubt that the range-finder must be a powerful auxiliary to the infantry, but as Captain Craufurd says, in certain phases of attack its use would hardly be practicable, I refer specially to the third zone of the attack—800 yards from the enemy's position. I think a correct principle in the attack for infantry is to advance rapidly so as to get within effective range of the enemy's position with as little loss as possible. If the firing line were to be delayed between each advance for the purpose of taking the range, it must necessarily suffer greatly increased loss. Besides, with the small-bore rifle of the present day, the question is whether in any case it is necessary to have range-finders within the third zone of the attack, for the trajectory is so flat, that with the fixed sight, which is, I believe, 350 yards, the bullet has a dangerous zone of 600 yards. The essential of a range-finder for infantry, especially in the attack, is that it should record the distance instantaneously, and so far as I know, no instrument has yet been invented that can do this. Undoubtedly for troops in second line, and occasionally for those composing the supports and reserves of the first line, range-finders would be useful. The lecturer said that the margin of error in judging distance is as much as one-third of the estimated distance ; I think this is excessive. The Germans lay down one-sixth to one-tenth as the margin of error, but if our error is so great it only shows the desirability and the necessity of our

having more practice in judging distances. I fear it is done in many battalions in a rather perfunctory way; once a month is hardly sufficient for practice. It is most essential for infantry especially that they should be able to judge distance accurately, and this cannot be done without incessant practice. The eye of the sportsman gets accustomed to distances from practice, and he mechanically adjusts his sight as he is going forward to shoot; and the infantry soldier should be so accustomed to judging distances that he should be able to estimate them within a few yards. Such accuracy is the more essential, because the objects fired at are generally moving and require rapidity of aim, like snap-shooting. I do not refer now to long or extreme ranges; for these it is, of course, very desirable to have range-finders. Colonel Salmond has called attention to a point which is very important: he pointed out that though the distance might be accurately taken, still the conditions of atmosphere, temperature, light, &c., would have a marked effect on the accuracy of the fire, making the strike of the bullets considerably over or under the objects aimed at. I think this might be obviated by using two or three different sights according to distance, as they do in foreign armies, the sights varying from 100 yards above the estimated distance to 100 yards below. In this way a larger area of ground will be beaten with bullets, and, though the density of fire will be less, it will ensure a certain proportion of the bullets striking the object aimed at.

Major WATKIN, R.A., Inspector of Position-finding: Colonel White has dealt with the tactics of range-finding in the field; there is another point which, perhaps, might be termed the strategy of range-finding. By this I mean the organization and training of men in the art of range-finding, which must exist before the advantages pointed out so ably and forcibly by the lecturer can come into operation. Up to the present the strategy which I should like to bring to your notice has been conspicuous by its absence. Do not let us introduce any range-finder or system of range-finding into the Service until it has been thoroughly tried, and when by such results as those shown to us to-day, and by such practical experiments as those so thoroughly carried out recently at Aldershot under the presidency of General Philip Smith, it is convincingly proved that the advantages to be gained are considerable; then (and this is what I think of such paramount importance), when you are satisfied of the gain to accrue, and an instrument or system is finally introduced, let the system be properly introduced and taken up *con amore* by the Service. Unless it is so introduced and taken up there will be no good results. In these days of scientific war, we, of all nations, can least afford to neglect the advantages of progress in mechanical and other sciences. I know from practical experience the horror Officers have of anything mechanical or anything in the shape of an instrument. How long has it taken to imbue us with (to take as an example) the advantages of an Officer being able to survey a road or a position? It is not so long ago that we looked upon a prismatic compass as beneath our notice, so I yet live in hopes that the day will come when a range-finder will be treated as a friend and companion. Owing to my official position, I am afraid of saying much as to our general position in regard to the subject, but I grieve to think that even now it is an acknowledged necessity (I am thinking more especially of coast defence), we do not take the thing to heart and give the training and encouragement, without which the mere possession of an instrument is valueless. I trust, therefore, that the strategy of range-finding will be taken into consideration, without which its destined effect on tactics will be *nil*.

Major F. W. STOPFORD, Grenadier Guards: It has been suggested that range-takers cannot keep up with companies in the attack. I have seen the experiment tried at Aldershot, and the practice carried out as nearly as possible under service conditions, the attack being made over rough ground: it was found that the range-finders could take the ranges correctly and quite keep up with the attack. I think it is very important that every company should have their own range-takers, and that the Captain should not, as has been suggested, have to look back to the Commander of the battalion in order to know what the range is. It has been said that men in action are not in a sufficiently calm state of mind to take ranges correctly. If men are in a sufficiently calm state of mind to fire as directed, and to take correct aim, surely they might take the range as well, which is not a more difficult operation than taking steady aim. When men cease to be able to take careful aim, and, generally at close ranges, the range-finder ceases to be of any value.

Captain H. GRENFELL, R.N. : I wish to ask Colonel White one question. He says that the artillery duel will commence at the extreme range of the guns. I should like to ask what he considers the extreme range of the guns at which fire could be effectively maintained.

Major WATKIN : Perhaps I might be allowed to allude to a remark of the last speaker but one with regard to men being unsteady under fire. I had the opinion of an Officer who has seen a great deal of modern war. I mean General C. B. Brackenbury, and he stated that his experience was that men who had definite work to do were not nervous ; it was when they had nothing to do that they were nervous.

Colonel D. M. CRICHTON-MAITLAND, Grenadier Guards : As an infantry Officer, I must leave the cavalry and the artillery to answer for themselves. I should like very much to have heard a sailor speak upon this point, because I have seen sailors use range-finders. I was on board the "Thunderer," with Admiral Colomb, some years ago, and saw him go into action. I saw that information as to the range was given by three marines from the hammock-netting besides the Officer in the tops, and the result was that the marines were thrown off the hammock netting at the discharge. I only bring this forward to show that sailors seem to prefer practical test shooting to the range-finder, possibly because range-finders are not sufficiently accurate ; any way they do not seem to trust them as much as we should expect it. From fixed batteries the gunnery practice was magnificent, owing to range-finders. With regard to infantry, two of my brother Officers have already spoken. Individually, I am of opinion that range-finding in the third zone of attack is nearly impracticable. I have tried it with instructors and musketry sergeants straight from Hythe, while the attack has been going on, and I found that they each differed more or less. I found also that the communication of the distances to the fighting lines was very difficult, and that when volleys were being fired, it was almost impossible to communicate the distances to the section Commanders without stopping the advance. If you are going to give us range-takers to be used in the field, by all means let us have them ; but they must be in addition to the present establishment of our fighting battalion. Now we find it very difficult to get the men to learn everything we are told to teach them. We have so many duties to supply at home, and we are called upon so incessantly to find men for this, that, and the other instruction—gymnasium, signallying, musketry, and the reconnaissance—actually, at this moment, if you told me to select non-commissioned officers and an Officer to send away for range-finding, I should have seriously to reduce the fighting efficiency of my battalion and number of section Commanders, thus affecting the control of the fire, which I think is as important as range-finding.

General Sir ROBERT HUMR : The large attendance present here to-day shows what a very interesting and important subject we have before us. I am glad to say that the lecturer has done full justice to his subject. Of course there are certain points in every lecture with which we do not quite agree. One that I do not agree with is when the lecturer says he hopes the day will arrive when stationary targets and range rifle practice will be done away with. I, myself, from my experience, do not agree with that at all, and I do not think that the practice at stationary targets is time thrown away, as I have often heard it said, because we have not got very much time to devote to rifle practice, and I think that the teaching of the young soldier is better carried out on the range and at stationary targets than it can be in the rather happy-go-lucky way in which you must carry it out if you practise only at moving objects. I do not think that the effect of rifle fire is so much influenced by the object at which you are firing moving, as it is by the individual who is pulling the trigger moving, and, therefore, you cannot assimilate the training of a soldier in peace time to his practice in war time, because until he becomes accustomed to have other people firing at him, and to have his nerves well under control, his fire will be much more affected by his own movement than it will be by the movement of what he is firing at. There is another point which seems to be left out of consideration a good deal in these days, which is that, although we increase the range of our weapons to an almost unlimited extent, we cannot increase or improve upon the ordinary sight of our men ; and I think that infantry soldiers should be sufficiently trained to be able to judge distances for themselves within

the distance at which they are capable of aiming. For I look upon it that aimed fire must be restricted to the distance at which a man can aim; after that it becomes unaimed fire, and then I do not see the advantage of the range being found for him at a distance at which he cannot aim. Now, it is a very different thing looking over a country, and seeing different objects and aiming at them; you can see a long way, and a man's sight practically ranges to a very long distance. But when the man is set to aim through his rifle sights at any particular object, he will find that a very few hundred yards exhausts the distance at which he can aim. I think really that for infantry in motion range-finders are not of much practical value, but for artillery and for infantry firing from a fixed position, they would be invaluable.

General Sir BEAUCHAMP WALKER: My Lord and Gentlemen,—Cavalry has been adverted to, not only by our lecturer but also by one of the speakers. Now, I have become such a fossil that I do not know whether any cavalry soldiers of the present day are here, but as no one has got up I am emboldened to say a few words. I think your Lordship will do me the justice to say that I never was an opponent of what was new or what was useful, and I have the greatest possible respect for the range-finder, not only from the experiments which I saw carried out in Germany, but also from the kindness with which Major Watkin was good enough when I was in office to come to me to explain the value of his very perfect instrument. I do not think the range-finder will ever be much used by cavalry. The effect of cavalry must be when brought close at hand. I doubt whether any cavalry soldier will take a long distance point and work up so as to bring his cavalry to good use at that point at some problematical moment. Every cavalry soldier ought to have an eye to country and be a pretty good judge of distance. I for one would never give a man the command of a regiment of cavalry who was not only a rider to hounds, but a good rider to the hounds. I do not know what is the case in the present day, but in the regiment in which I served at home everybody hunted more or less, some of us with very poor horses, but we all hunted. I believe that a good eye to country gained by riding steadily to hounds will always be of use for leaders of cavalry in the field. And, as regards cavalry, giving every possible value to the question which we have been discussing to-day, a good eye to country gained as a sportsman will be of more value to an Officer in command than the range-finder. I do not at all attempt to deny that the range-finder may be useful, but I do not think it will be as useful to cavalry as to other branches of the Service. I am sorry, I must honestly confess, because I have no doubt that you put me down as behind the times, that the use of fire-arms is said to be indispensable to cavalry. I believe that the true weapon of cavalry is the *arme blanche*. Unfortunately for that feeling on my part, the necessity for cavalry dismounting and defending a position has become so absolutely necessary in the present day that the fire-arm is nearly as much thought of as the *arme blanche*.

Lieutenant-Colonel WHITE: I do not think there have been many serious objections made to what I have said, and I am not surprised that there should have been some little criticism on the part of those who have had so much new matter suddenly brought to their notice. Considering how impossible it is for any one to convey his entire meaning in the first reading of a paper, it is only natural that here and there my point should have been missed. Some of the speakers, I noticed, alluded to the delays which range-finding must entail upon infantry. This showed that they had not yet grasped the central idea of the new system I have been trying to describe, which is that the ranges are ascertained as rapidly as the words of command for successive volleys can be given. In what I have termed the instantaneous method it takes about 30 seconds to begin, and after that the readings of the range of objects, moving or stationary, follow each other easily at the rate of four a minute, so no time need be lost. Again, it was doubted if range-takers could continue to work under fire. I maintain that they can do so, as long as anything else can be done requiring care and skill, but that without doubt, whenever (if ever) the danger is so great that men cannot shoot straight, fire discipline will fail and range-finding fail also. At that stage, however, range-finding, as I pointed out, would no longer be necessary. You will perhaps recollect that I made some reference to impending changes in fire tactics independent of range-finding. In so

doing I had in my mind certain ideas now in evolution on the Continent, which must eventually have great weight in this country, and I rather hoped that some here would have followed up with a fuller statement of this new departure in tactics. The Germans, it seems, are coming fast to the conclusion that with the new rifles it will not be possible for the attack to traverse the fire-swept zone with its own fire reserved, and I submit that range-finding will accentuate this tendency, and that the nature of the attack must undergo change. I never could pretend that range-finding was applicable to those cases so often described, where an attack is a maddening rush, in which one wave of men catches up another just as it breaks, and by sheer impetus carries it one stage forward, then breaks itself, and is similarly overtaken and impelled onward by a third wave, and so on until the goal is reached. That character of attack held good for short distances only, when the zone of extreme danger did not extend beyond 400 yards, but in future the area swept by rifle fire will be too great to be got over in this fashion; hence the German idea of gaining ground systematically by fire action alone. In any such systematic fighting I do not see why range-finding should not be practicable. A body of infantry advances to a given position, finds its range, and opens a steady destructive fire, while another goes in a little closer and brings *its* power to bear; the process being repeated and the ranges gradually reduced until range-finding is no longer needed. Remember, in going over 1,500 or 2,000 yards, cover will be far more easily got than in those rushes we have hitherto thought of over a smooth 500 yards. Now about *pace*. I assure you that a range-finding party can quite keep up with an infantry attack. I accompanied an instructional attack myself at Aldershot not long ago. It was delivered very quickly, certainly much quicker than it would have been on service—so fast did we go that at the end I was glad to throw myself down full length on the heather just to recover my breath—yet we took the ranges all through, and were correct in all but one. In such cases individual readings may be wild, like individual shots, but the average will be reliable, and the work of one party will check that of another; for there must be many parties of range-takers, some working and others in reserve, when each independent fire unit finds its own ranges. Apropos of the effects of range-finding in musketry, I will just tell you what we did one day the year before last. A party was taken to field firing against infantry dummies, starting from about 1,200 yards range. They first judged their own distances and fired a certain number of rounds, then, without knowing the results, went forward again under range-finding control and fired the same number. What happened, do you suppose? Why, although *tired* in the second advance, they scored 96 hits then, against 56 made the first time (when without range-finding).¹ If you will consider what this proportion means, you will allow that it would be a gain in fire effect to spare two range-takers with their rifles from so small a fire unit as *twenty* men *even*, if you could thereby make sure of the correct range.²

Colonel CRICHTON-MAITLAND: Were they using ball cartridge or blank cartridge in the rapid advance of which you spoke?

Lieutenant-Colonel WHITE: At the time we were running so fast and taking ranges for an attack, a peg was driven into the ground at the spot from which each range was found, and the distances were afterwards verified. The other time I mentioned, when we made 96 to 56 hits, we, of course, fired ball cartridges.

Colonel CRICHTON-MAITLAND: May I ask how many men are required?

Lieutenant-Colonel WHITE: Two men are needed in the particular method I described to find a range, and the Officer who gives the word of command regulating the fire must take down the readings, and must also *predict* if the object is moving, but I do not see that he loses the command of his men because he thus takes advice as to the distance the enemy are from him. Suppose he does without a range-finder and guesses his range. He thinks it is 1,100 yards, say, when it is only 900 yards.

¹ At this rate, two companies under range-finding control would overmatch three companies judging distance by eye.

² It should be remembered that the range-takers would fall in and use their rifles at 600 yards or thereabouts, when the changes in the range necessitated no change of "*sight*;" hence they are not lost to their company.

Would you contend that he is then usefully superintending his men ; whereas if he consults the range-takers and they give him the distance within 20 yards of what it is, and he fires accordingly, would you say that he was taken away from his proper duties in regulating the fire ? I maintain that in the latter case he is commanding his men far more effectually than in the former.

Captain GRENFELL : I ask, what, from your experience in connection with range-finding, is your idea of the limitation of practical range, supposing we could get a gun which would range to great distances.

Colonel WHITE : With regard to range-finding only ?

Captain GRENFELL : Not with regard to range-finding. Supposing you had a gun that could shoot to any distance, what figure had you in your mind when you spoke of the extreme range ?

Lieutenant-Colonel WHITE : I had in my mind a range of about 5,000 yards, but there is no finality in such matters. You might, for example, put more powerful telescopes to the work, and that might increase the distance. To be effective, guns must be pushed up to a range at which the objective can be identified, and this must not exceed that at which the gun has been found to be effective when fired in experimental trials, as at Shoeburyness, on a known range with the laying instrumentally correct. These are the only limiting conditions. Sir Robert Hume spoke of the necessity for stationary targets in musketry training. I never meant to suggest that the individual training of the soldier as a marksman should be neglected. It is individual training in the first instance that makes a man able to shoot at all, and this must begin with a stationary target ; but I think that when you come to *serious practice* the men should be taken collectively, and should be accustomed to fire at moving targets.

Sir ROBERT HUME : My idea is that men should be taught to shoot at stationary targets.

Lieutenant-Colonel WHITE : Sir Beauchamp Walker did not quite agree with my remarks on cavalry. I had, however, no intention of discussing cavalry tactics,¹ and merely wished to suggest that a knowledge of *distance* and *pace* might be often useful to cavalry Officers, who might otherwise hesitate as to whether such and such a thing could be done or not. Cavalry must often be kept a long time in one place during the progress of a battle, waiting for their opportunity. In such cases would there not be ample time for a little range-finding ?

Lord WOLSELEY : Ladies and Gentlemen,—We have listened to a very interesting lecture, and if I may say so, to a very interesting discussion. Several of those who have taken part in it have turned our attention to points which I think were perhaps not very pointedly mentioned by the lecturer, but at any rate they are all points well worthy of consideration. If I were asked, what is the most important lesson we have derived from this afternoon's lecture, I should say it is the absolute necessity which becomes more apparent every day, that we should all try and think out for ourselves what the battle of the future will be like. That is the great thing we have to try and find out for ourselves, because it is upon what will be the nature and conditions of the battles in the next great war, will depend entirely what tactics we shall teach our Officers and the mode of fighting we should teach our men. As regards range-finding pure and simple, there can be no doubt it is a most valuable service, or art perhaps I should call it, for most fighting men. For the Navy notably, and for all coast batteries when applied as it has been recently by my friend Major Watkin, to a system of "position finding." There can be no possible doubt as to the necessity for paying the subject very close attention. I think very few will dispute its great value to all field artillery. You have only to see at Okehampton how difficult it is without a range-finder to ascertain the ranges at long distances, and how simple it is to do so by means of a range-finder, before the battery is brought into position. A few minutes attention on the part of the range-finders enables the exact range to be found at long distances. With the distance accurately measured the battery comes into action under very favourable conditions.

¹ No opinion was expressed in the lecture as to the question of cavalry resorting to *fire-arms*.

The guns quickly laid, by order of the Major commanding the battery, at the required elevation, good practice is immediately secured. On the other hand, all foreign nations who discard the use of the range-finder have to go through a process of firing over and under, a process which often takes some considerable time in bad weather. This is especially the case where the ground is very soft, rendering it difficult to mark the exact spot where the shell bursts on striking. Those difficulties are got over by our range-finding system, and I think anyone who has seen the recent practice at Okehampton will thoroughly endorse all that our lecturer has said as to the immense advantages, in fact, the desirability, of improving our system of range-finding for the field artillery. Then comes the question of range-finding for infantry in action, and that is a much more difficult subject to deal with than the other to which I have referred. It is a point that I am sure will be open to very great differences of opinion for a long time in all armies. But there can, I think, be little doubt that, since we have adopted a very long-ranging rifle, which gives accurate practise at distances beyond the power of ordinary sight, it is very desirable to practise our men in long-ranging fire. Long-ranging infantry fire is an art that is really in its infancy. We have not even had in recent years, that I know of, any very interesting or very exhaustive experiments in this sort of fire. About eight years ago we had some very useful and instructive experiments in long-range volley fire at Lydd with the Martini-Henry rifle. The results of those experiments were most satisfactory, and anyone who read the statistics derived from them must have felt what a very powerful future there is in store for the infantry arm when used intelligently at long ranges. But in order to so use the infantry arm, the more long ranging the arm, the more is it requisite to have a good range-finder. Anyone, therefore, who attaches, as I do, much importance to long-ranging volley fire, will at once recognize the enormous importance of the range-finder for that object. The instrument must no longer be a plaything, as it has hitherto mostly been, but its use must form part of the regimental training system of our infantry soldiers. Up to this point what I have said will, I think, be generally agreed to by most of the infantry Officers whom I have the honour of addressing. But now comes the question, what is the use of range-finding at short ranges? Whenever this question is debated, we find about the same difference of opinion which we have heard expressed here this evening. I confess I do not myself believe in the possibility of using it at close quarters. I speak subject to great correction, for it is possible one might think differently after having seen experiments carried out with the range-finder in the midst of the skirmishing line; but from my small knowledge of war, and from what I have seen when under fire myself, I do not think it is possible to get men in heat of action, when under a very heavy fire at, comparatively speaking, close quarters, to use a range-finder to any practical purpose. Close quarters for an arm of great precision like ours may be said to mean from 300 to 700 yards. If acting on the defensive, in a position which you have occupied for an hour or more before, the range-finder will naturally be of the greatest use to you. As the lecturer told you, you will then be able to ascertain, before the arrival of your enemy, your distances from all the remarkable trees, houses, ditches, and fields in your front and flanks. Range-finding will, therefore, be of immense use to infantry under those circumstances, even up to point-blank range. But with infantry attacking a position, when it gets within 700 or 800 yards, that is, well into the third zone, I do not believe it will be possible to make use of any range-finder that I have ever yet heard of, to any practical purpose. I may be mistaken, and I do not wish, therefore, to be regarded as standing in the way of any invention that can possibly be of use to the Army. At the same time, before we take away a certain number of men from every company in the Army, in this small army of ours, it behoves us to think of the cost, and of what it is we are to get in return. I do not mean a cost in £ s. d., but in men, the cost to a regiment and an army from which you withdraw a number of men who would otherwise be effective riflemen in action. In other words, if from a company of 100 men, or say of 60 or 50 men, to which it would be very quickly reduced if you begin the campaign or even the battle with a hundred, you have to withdraw two or three of your most intelligent men, it means that you lose during your day's fight some 300 or 400 rounds of ammunition that you could otherwise have fired at your enemy.

There is one use to which the range-finders can be turned with great advantage which has not been referred to. I mean in military surveys, and for all purposes of reconnaissance. In 1879 poor Sir George Colley, a great friend of mine, who was with me in Zululand, used a range-finder for the first time in making a survey he was employed upon. He used the Watkin range-finder, and his report upon it to me was :—"This range-finder marks a new era in all reconnaissance and all survey work." I hope this will be remembered by all those who have to teach road-sketching, reconnaissance, or surveying as now taught, I am glad to say, so very largely in our Army. A point of some importance has been raised, I think chiefly by Sir Robert Hume, in reference to the use of stationary targets. All will agree that we ought to do all we can to reduce our peace musketry practice to active service conditions as far as possible. That is absolutely necessary, if we wish our soldiers to be really effective in the field, and in the day of battle. A great question to be decided is, what is the best means of teaching your soldier to shoot? Most of us who are fond of shooting began by shooting at sparrows sitting on a tree. But after we had as boys learnt to shoot those sitting sparrows, we did not in after life, when we had acquired the power of shooting birds upon the wing or animals running, keep on still practising at stationary objects. Now, my own idea is, we should act similarly with our soldiers in their annual musketry practice. Let us teach our soldiers at first to shoot at a target, and when they can do so easily, then practise them annually in field firing. After the soldier has been well taught to aim, shoot, and hit a target, is it not ammunition thrown away in subsequent years to put him in front of that big target and ask him to fire 10, 15, 20, or 30 rounds at it? To keep up your own shooting you don't do this yourself; then why do it with the soldier? Surely the man who has once acquired the power and art of hitting a target should for ever afterwards devote all his annual allowance of ammunition at practice as nearly as possible resembling the conditions under which he would have to fire in the field. As regards cavalry, I endorse what my friend Sir Beauchamp Walker says, that except for surveying, for reconnaissance, and scouting work, I cannot see how the range-finder could be of any use to cavalry. I entirely agree with what he says as to the proper use of the cavalry soldier, namely, to fight on horseback. It is because I am so fully imbued with this idea as to the province of the cavalry soldier that I am so anxious to see added to every cavalry division a certain number of mounted infantry, who shall go with it, and save the cavalry from having to dismount and adopt a line of fighting which is not theirs, and which, if called upon to do, they will generally do badly. I have now, in your name and on your behalf, and I am sure I am fully justified in doing so, to convey our best thanks to the lecturer for the very interesting lecture that he has given us.

Friday, February 14, 1890.

ADMIRAL H. BOYS, Vice-President, Vice-Chairman of the Council,
in the Chair.

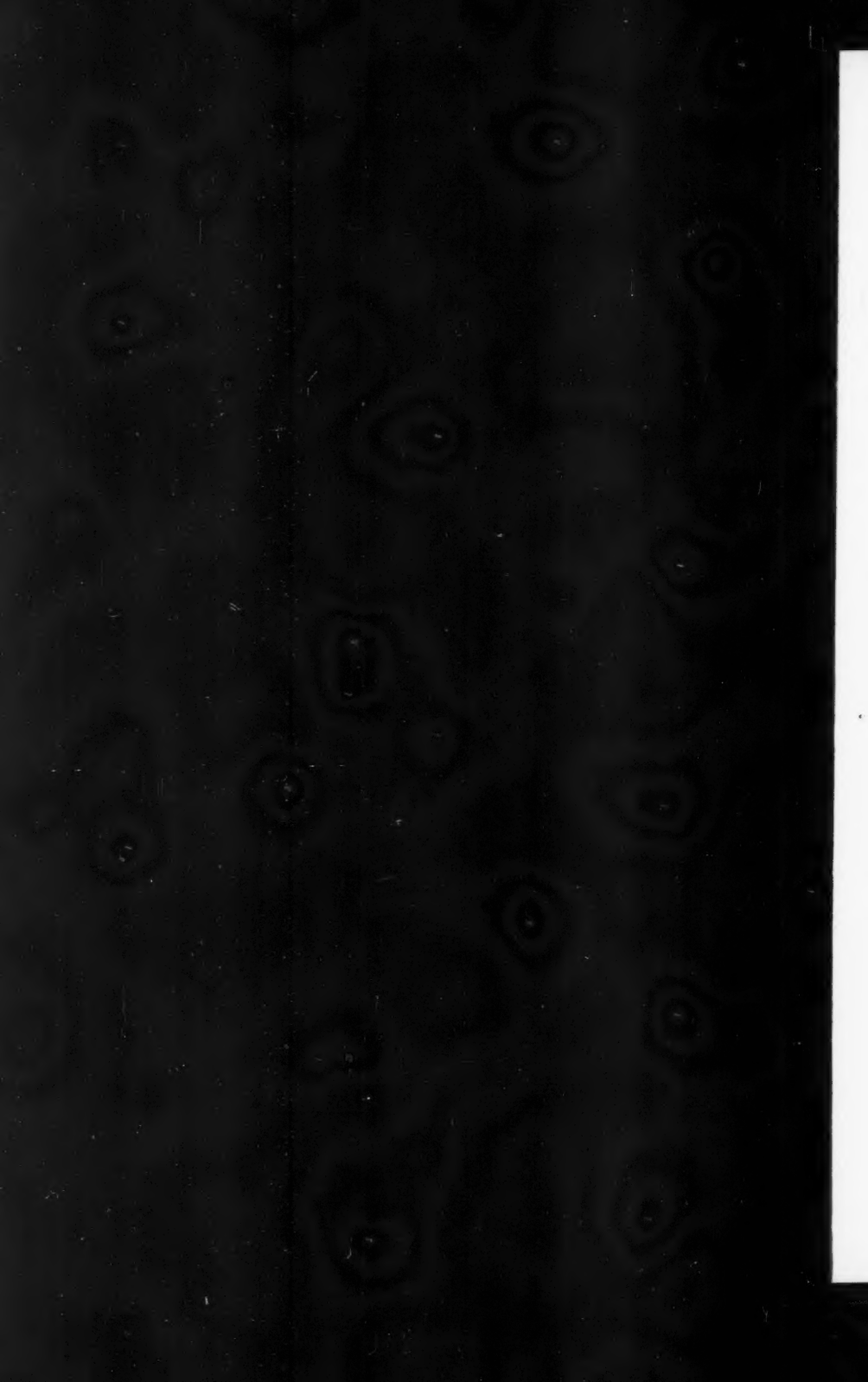
THE SHIP'S CHRONOMETER, ITS HISTORY AND
DEVELOPMENT.¹

By HENRY DENT GARDNER, F.R.G.S.

Historical.

IN tracing the history of the ship's chronometer, it will make our subject more interesting if we will endeavour, for one brief moment, to put ourselves in touch with the era which preceded its existence. The early explorers had completed their great voyages and geographical expeditions, and had sketched out for us in rude outline the greater portion of the map of the world which we have to-day; but the difficulties of navigation were enormous. With the obscurity which attended the determination of the longitudinal positions of their ships it is hardly a figure of speech to say that navigators must have groped their way from sea to sea. In a typical atlas of the middle of the 17th century I find the longitude of such places as the "Cape," Cape Horn, Cape Race, Cape Comorin, in error from 6° to 12°, and if such was the confusion on land, we may be sure it was very much greater at sea. I am informed that it was no unusual thing for ships, after securing as nearly as possible their proper parallels of latitude, to go sailing on, haphazard, until they should stumble, so to speak, upon the shores at which they were aiming. In order that I may make the subject clear to all, let me speak for one minute of the method by which longitude is determined. To ascertain your longitude you must know the local time of two different places; you must know the local time (the what o'clock it is) of the place where you are; and you must know the local time (the what o'clock it is) of the place from which you started, or from which you wish to measure. The difference between these two "times" will give you your longitude, east or west, at the rate of one degree of arc for every four minutes

¹ The paper was illustrated by models and instruments kindly lent for the occasion by the Science and Art Department, the British Horological Institute, and Mr. Thomas Buckney, F.R.A.S.



Friday, February 14, 1890.

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of time. So now it is evident how the question of longitude connects itself with the ship's chronometer.

Towards the end of the 17th century men's minds were getting very busy with this question of how to determine the longitude at sea. There was not so much difficulty in finding the local time of the ship's position—the perplexing point was how to get at the corresponding local time of the place from which the vessel had started. Such watches as existed in those days were totally inadequate to carry the time with sufficient accuracy; they would lose or gain at the rate of one minute a day for every 10 degrees rise or fall in temperature, and would not continue going whilst being wound. Indeed the idea of obtaining a portable time-keeper of sufficient accuracy was at first derided. On the other hand, astronomical methods such as could be used at sea were equally imperfect; there were no proper lunar tables, no reflecting quadrants, and Greenwich Observatory itself had only just been founded. Endeavours were made to make use of pendulum clocks at sea, and I may mention that their great advantage (if they could have been employed) would have been in the fact that they would have been affected by changes of temperature in comparison with a watch only to the extent of one-fifteenth.

Rewards for means of determining the longitude at sea had been previously offered by the Spanish and Dutch Governments; but in 1714, so urgent had the question grown, the British Government offered a reward of 20,000*l.* to anyone who could find means of discovering the longitude at sea to within half a degree. By the Act of Parliament a Board of Longitude was created, and this Board had power to assist inventors and give smaller awards of 15,000*l.* and 10,000*l.* for methods of determining the longitude to within two-thirds of, or one whole degree. The offers of such large sums of money naturally stimulated both astronomers and clockmakers, but no discovery of anywhere near sufficient accuracy ensued until the year 1735, when a certain John Harrison, a native of Yorkshire, and the son of a carpenter, made his appearance in London with a time-keeper which he had invented and constructed. In a paper read long afterwards before the Royal Society, there is a most interesting account of his interviews on that occasion with Dr. Halley, the celebrated astronomer, and Graham—whose invention, the astronomical clock, still maintains its position with but slight alteration in every observatory in the world. Although they were both competitors with Harrison for the great Government reward, they afforded him every assistance, and it was owing to their certificates that he was permitted to proceed with his time-keeper in a king's ship to Lisbon, where it is stated that he was able to determine the longitude to within 1° 30'. Upon this success, Harrison received the assistance of the Board of Longitude to the extent of 500*l.* to enable him to proceed with his experiments. For a prolonged period he continued his researches, and constructed a second and a third time-keeper. His third time-keeper was an entirely new departure, his former ones having been made more upon the model of clocks than watches. Harrison's third time-keeper, which with his previous ones is deposited

in Greenwich Observatory, resembles in most respects that very interesting instrument made by his apprentice, and used by Captain Cook, which is the property of this Institution. Harrison's third time-keeper was despatched upon a trial voyage to Jamaica in 1761. On its arrival there it was found to be in error but 5.1 seconds, and on its return to Portsmouth, in 1762, its complete variation for the whole voyage amounted but to 1 minute 54.5 seconds. Upon this result Harrison claimed the reward; but he did not get it until three years afterwards—after another voyage and further trials. We have, fortunately, a day to day record of the performance of this historical chronometer at the Royal Observatory, which I have, in order to facilitate comparison with modern instruments, reduced to the present method of weekly sums of daily rates.

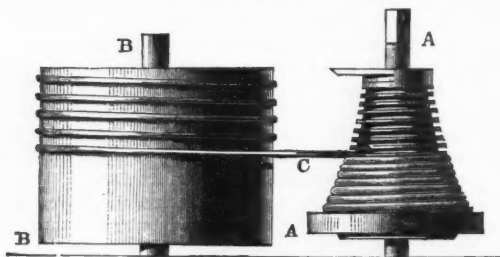
1766.	Seconds.	Mean temperature.	1766.	Seconds.	Mean temperature.
July 16	+ 132.2	63°	November 19	+ 131.6	48°
" 23	+ 137.2	63	" 26	+ 126.3	50
" 30	+ 136.3	60	December 3	+ 112.6	43
August 6 . .	+ 126.8	63	" 10	+ 111.0	40
" 13 . .	+ 88.4	64	" 17	+ 123.3	43
" 20 . .	+ 70.9	61	" 24	+ 96.6	38
" 27 . .	+ 80.1	64	" 31	+ 54.4	37
September 3	+ 82.9	63	1767.		
" 10	+ 91.8	59	January 7..	+ 6.3	34
" 17	+ 81.3	57	" 14..	+ 21.3	30
" 24	+ 86.1	62	" 21..	+ 39.3	31
October 1 ..	+ 80.8	58	" 28..	+ 72.1	38
" 8 ..	+ 81.1	58	February 4	+ 107.6	46
" 15 ..	+ 95.1	49	" 11	+ 110.3	43
" 22 ..	+ 121.7	50	" 18	+ 118.1	45
" 29 ..	+ 140.5	52	" 25	+ 117.4	44
November 5	+ 141.1	50	March 3....	+ 127.3	45
" 12	+ 124.3	44			

+ signifies gaining.

Descriptive.—Historical.

It must now be my endeavour to explain a little of the technical construction of the ship's chronometer, and to speak of the properties and conditions upon which its time-keeping qualities depend. First of all, there is a mainspring, and, like all other springs, the further it is wound the harder it pulls. You cannot see the spring (Fig. 1) because it is contained in the barrel, BB. A chain, C, connects BB with the contrivance, AA, which is called a fusee. The function of the fusee is to equalise the power of the mainspring, for when the mainspring is wound furthest it acts upon the thinnest part of the fusee—that is, on a lever of shorter radius; and when nearly down

FIG. 1.



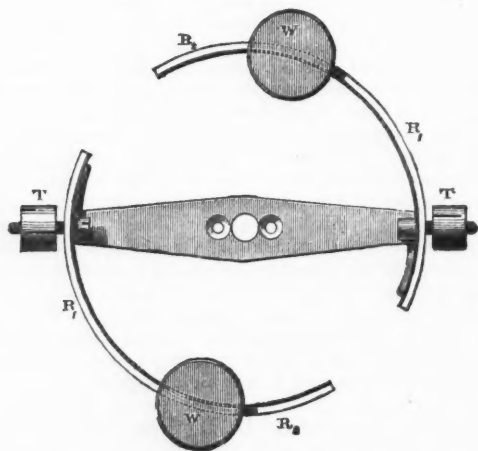
on the thicker portions of the fusee—that is, on a lever of longer radius. Riding upon the arbor of the fusee is the great or first wheel of a succession or “train” of wheels. The object of this train is to convert the strong pull of the mainspring, acting for a few turns, into a feeble force at the escapement, acting for many turns. Thus the last wheel in the train of a two-day chronometer generally goes round about 3,000 times against a single turn made by the great wheel, and, were it of the same diameter, would press against the escapement with $\frac{1}{3000}$ part of its force. The escapement is that portion of the mechanism which converts the continuous motion of the wheels into the reciprocating motion of the balance. The vibratory motion of the balance is maintained by a spring against which it is thrown at each beat of the escapement. It is this spring which generally shows so conspicuously in every watch and chronometer. On account of its remarkable property, this spring is often called the pendulum spring, for, like the cycloidal pendulum, it possesses, when truly adjusted, the quality of isochronism—that is, it is able to compel the balance to perform long or short arcs of vibration in equal times. This quality is a mathematical consequence of the fact that the further the spring is deflected, in direct proportion, so much the harder it will push. Dr. Hooke, who discovered this fact, gives it in the form “*Ut tensio sic vis*,” a statement which he concealed in the form of an anagram for some years. It is upon this quality that the time-keeping capacity of all watches and chronometers in the first instance depend. Until the time of Harrison, however, this spring was practically useless for all or any purpose of accurate time-keeping, by reason of its being so greatly affected by change of temperature. If the experiment were tried it would be found that an uncompensated time-keeper if adjusted to go right at a temperature of 32° would lose 6 minutes 25 seconds a day at a temperature of 100° . It was Harrison who was the first to correct this error. Knowing that brass expanded more than steel, he took an equal strip of each metal, and fastened them securely together side by side. The result which followed was this, with an increase of temperature his strip of compound metal bent over on the side towards the steel, and with a decrease of

temperature his compound strip bent over on the side of the brass. Thus, he got motion following upon a change of temperature, and he applied it to the pendulum spring, just upon the same principle as is used in ordinary regulation. Everyone knows that to make a watch go fast or slow the regulator must be shifted, and Harrison's "compensation curb" was an automatic regulator following change of temperature. Harrison's other inventions consisted of the "going fusee," which enabled the time-keeper to keep going whilst being wound; he also used a train *remontoire* which intercepted variations in the friction of the train of wheels from reaching the escapement, and he employed a novel form of escapement in which the action was more direct, and the arc of vibration was more extended. When Harrison invented his compensation curb, he did not know where to put his regulator, for if he had put the regulator in front of the curb the curb would have been useless, and if behind the curb the regulator would have been useless. So he did without one, and this accounts for the wide daily rate of his chronometer from mean time. It is curious how the same thing seems to have puzzled Mudge, Cumming, and Berthoud. Thus Mudge had two pendulum springs, one for the regulator to act on, and one for the curb to act on. In Cumming's chronometer, the compensation consisted in applying an open ring of brass to the interior of a closed ring of steel, and the brass expanding more than the steel, lateral motion between the rings ensued upon a change of temperature. And Cumming having fixed his pendulum spring to the end of a lever worked by the expansion of the brass ring, it was so pushed or pulled through the curb pins. Berthoud used an apparatus similar to the gridiron pendulum in clocks for obtaining motion upon a change of temperature; but he had not only two pendulum springs but two balances geared together, one pendulum spring being attached to one and one to the other. The idea of having two balances geared together originated, I believe, with Dr. Hooke, and its object was to prevent the turning of a ship affecting the going of the chronometer. For if two balances are geared together, you have one moving one way and one the other, and any circular motion which would accelerate one would retard the other, and the mutual effects would cancel. We recognize in these days such arrangements to be illusory and mischievous, for our modern balances turn so fast (at the rate of about $1,800^\circ$ in a second) that there is no time for the ship's motion to take effect. Harrison's chronometer had no gymbals, as he considered them (a notion very much opposed to ours) detrimental. On the other hand, he desired that the position of his time-keeper should be shifted in its box, so as to counteract the "lie down" of the ship, and this as often as the ship changed her tack. I may remark, however, that it is very necessary that a ship's chronometer should hang steady in its gymballing; sometimes a slight tremor may be noticed following each vibration of the balance, and this is highly prejudicial.

It was a Frenchman, Le Roy, who made the first great advance upon Harrison's chronometer. Le Roy dispensed with anything in the form of a compensation curb, and adapted the compensation to

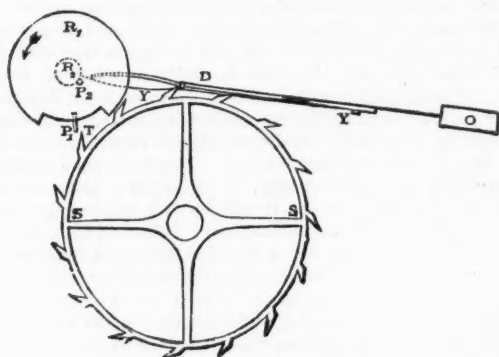
the balance. After all, the balance is only a kind of fly-wheel, and according as the weights upon it are put nearer to or further from its centre, so it will gain or lose. Le Roy applied a mercurial thermometer to the balance, the bulbs being outside and the stems turning inwards, so that when there was a rise of temperature the mercury moved towards the centre, reducing the moment of inertia, and so counteracting the loss of elasticity of the pendulum spring. This was a great improvement, because the pendulum spring in which the time-keeping property of the chronometer resides was not interfered with. In these days, no one would think of doing anything to disturb the pendulum spring, and when a chronometer requires regulation, there are some little screws upon the balance which are turned inwards or outwards. Mudge, who followed Harrison in England, still continued to use the compensation curb, and I think made no great advance, although he got 3,000*l.* from the Board of Longitude. His principal work was to adapt the *remontoire* to the escapement. It is true this invention may have led the way to the use of the gravity escapement in turret clocks, but it turned out of no service to the marine chronometer. The next great inventor and improver of the marine chronometer to follow Harrison was Arnold. Arnold (unless we are to believe certain French writers who give preference to Le Roy and Berthoud) entirely remodelled the fabric of the chronometer, and, in any case, there is no doubt that his patents of 1776 and 1782 are conspicuous steps in advance. Arnold, instead of using a thermometer like Le Roy, applied Harrison's method of joining brass and steel to obtain a bending movement upon the rim of the balance. In Fig. 2 is shown the principle he adopted. R_1R_2 , the

FIG. 2.



rims of the balance, are steel inside and brass outside, the steel and brass being firmly united. Upon a rise or fall of temperature, the rims will therefore bend either inwards or outwards, carrying the weights, WW, with them, and compensating by the change of inertia for the loss or gain in the elasticity of the balance spring. By shifting the weights forward or backward along the rim, the action of the compensation is increased or diminished. The screws, TT, are for altering the time of the chronometer as already intimated. Arnold also altered the form of the pendulum spring; hitherto it had been shaped as a flat spiral, but Arnold put it into the form of a cylindrical helix with incurvating ends, "rendering all the vibrations of equal duration, because the figure is always similar to itself." Lastly, Arnold produced the celebrated detached escapement (see Fig. 3). SS is the escape wheel, which is now being held by the

FIG. 3.



detent D. R_1, R_2 are two rollers, the smaller being situated in the plane of the detent, and the larger in the plane of the escape wheel; both are on the same spindle as the balance. The balance is now turning in the direction of the arrow; by-and-by, the finger P_2 upon the small roller will come round and lift away the detent, and the wheel will be free. The tooth, T, will then drop upon the impulse pallet, P_1 , and deliver impulse to the balance. Meanwhile, the finger, P_2 , gets clear of the detent, which it allows to fall just in time to receive the succeeding tooth of the escape-wheel. The balance now passes on to the limit of its excursion and returns, but in returning the finger does not interfere with the detent, for the detent, D, is actually too short to reach it. Just now, the finger really unlocked the detent by means of the little spring, YY, which is fastened some distance down the detent, the little spring being supported by the horn, or extremity of the detent; but when the finger returns, it

merely lifts out the spring, as there is upon this side no horn or extremity to support it. Both the balance shown in Fig. 2, and the escapement shown in Fig. 3 would be technically described as Earnshaw's, because they are in the form in which they were left by Earnshaw. Earnshaw's balance differs from Arnold's in respect of the method of making, and Earnshaw's escape-wheel has a differently formed tooth to Arnold's. In Arnold's wheel, the tooth had the figure of an epicycloid, which got worn in practice. Earnshaw was a chronometer maker of high mechanical ability, and he carried the improvement of the chronometer so far that, after his time, the Government offered no more great rewards. It is proper to mention that Arnold's inventions were rewarded with the sum of 3,000*l.* from the Board of Longitude.

Descriptive.—Modern.

As I am now approaching to within measurable distance of our own times, I will no longer pursue the historical method which has been adopted hitherto, but, taking the marine chronometer as I find it to-day, will endeavour to describe to you its perfection and imperfection, and what are now the best methods adopted of testing and rating it. Marine chronometers are made to go for 8 days or 2 days. The 2-day instruments, unless for some very particular reason, are to be preferred, as they have higher numbered centre-pinions, and they admit of larger and heavier balances. Moreover, the 2-day chronometer should be wound every day. If you open a 2-day chronometer, the most conspicuous part of it will be the balance and pendulum spring, the wheel-work and escapement being hidden between the frames. The brass frames are not gilded as watch frames are; they are better "spotted" and polished, because gilding softens the metal a little. The holes in which the pivots of the balance and the escape-wheel play are jewelled. The lower seconds wheel pivot hole is jewelled, as is also sometimes the upper. The holes in which the pivots of the centre wheel, fusee, and barrel arbor play, are generally left in brass, the friction of a brass hole being somewhat sweeter where the pressure is great. The mainspring is enclosed in its box, and cannot be seen, but it should have been hardened and tempered, and well polished, and great care should have been taken to avoid anything like "grinding." The fusee adjustment should also have been carefully tested, to ascertain that the pull of the mainspring (increasing as it is wound up) was properly balanced by the decrease in the diameter of the fusee. The gearing of the wheels should have been run with great care. The numbers of the teeth in the wheels and pinions are usually as follows:—Great wheel, 90; centre pinion, 14; centre wheel, 90; third pinion, 12; third wheel, 80; fourth pinion, 10; fourth wheel, 80; escape pinion, 10; escape wheel, 15. If I start the balance of a chronometer, and watch the "getting up" of its vibration, I shall see that it will gradually reach to an arc of about 225° on each side of the position it started from, which we will call zero. This means that the complete swing of the

balance will be about 450° , which would be technically called $1\frac{1}{4}$ turns. The complete vibration should be not less than 400° or over 500° . The angle of impulse does not much exceed 40° , and, as you remember, the wheel only gives impulse at every other vibration of the balance (see Fig. 3). If we add twice five degrees, which is about the angle of engagement of the little finger P_2 with the spring, YY , during each vibration, we shall find that during two complete vibrations, amounting in all to about 900° , the balance is only in connection with the escapement for about 50° , and swings for the remaining 850° free and undisturbed. There is no other escapement so detached as this is, and, moreover, the impulse being so direct, it needs no oil, which is an unspeakable advantage. It is sometimes curious to find, after several years of going, that the hard jewel impulse pallet, P , has been worn away and pitted by the action of the brass escape wheel, which remains itself unimpaired, whilst the gold passing spring, YY , which has probably been lifted some 300 million times during the same period, is but slightly marked. Although the balance is so little under the action of the escapement, it must not be forgotten that it has the varying friction of its own pivots to disturb it. Changes of barometric pressure can have but little effect upon the going of chronometers; indeed, if the isochronism be good, within ordinary limits the effect must be unperceivable. Some years ago I placed a marine chronometer under the partial vacuum of the receiver of an air-pump. The pressure was from 13 to 21 inches, and the trial lasted 7 days. At the normal pressure the balance vibrated 440° , but it rose to 472° at 15.5 inches, and 495° at 13 inches. On the other hand, the rate at the normal pressure was -0.3 seconds daily, and its rate within the vacuum $+0.2$ seconds daily, which shows a difference of 0.5 seconds daily, due to a change of pressure averaging about 12 inches. The temperature was uniform throughout the experiment.

In the making and adjusting of the pendulum spring the utmost care and skill is requisite. After the spring has been hardened, tempered, and polished, it is put in position, and a series of trials are conducted. These trials are sometimes somewhat laborious. The chronometer has in the first instance to be got tolerably near, in and out of the oven. Then the isochronism is tested; this is done by letting down the ratchett, which reduces the power of the mainspring, and the arc of vibration in consequence is lowered. If the isochronism is found to be imperfect, the chronometer must again be tested in the oven, because in the oven the vibration is always increased by the action of the heat upon the oil, and errors of temperature and isochronism are mixed up. This process is repeated until compensation and isochronism are found to be correct. It is tolerably well understood that isochronism within certain limits as to length depends upon the form of the spring. But how complicated the question is has been well shown by an experiment of Mr. Kullberg's. Having isochronised a chronometer with an ordinary non-expansion-balance, he replaced the balance by one with cut rims, as shown in Fig. 2. On again testing the isochronism, he found it from 12 to

14 seconds a day fast in the short vibrations, and he attributes this difference only to the increased pull of the centrifugal force upon the cut rims of the second balance. There is a singular error which exists at first in many chronometers, a tendency to accelerate or gain upon their rates. Mr. Kullberg attributes this to a want of homogeneity due to tempering, one side of the spring being in tension, and the spring as a whole therefore weaker. As a consequence of the spring being always in vibration, he considers that homogeneity is in time restored, and so the spring gets stronger. It is desirable that chronometers should be left some 2 seconds a day fast in the short vibrations, because in the natural course the vibration falls off through the thickening of the oil, and the excess of gain in the short vibrations will about compensate for that independent retardation which is due to it. If a chronometer keeps regularly losing upon its rate, it is very probable that the pendulum spring is rusting, and losing its force in consequence. All springs intended for the Admiralty are now left white, as it is found that white springs are less attacked by rust.

In a paper read before the British Association in 1834, the author (the late E. J. Dent) gave some very interesting particulars respecting springs of different materials which he had been experimenting with. He found that whilst a chronometer with a glass disc for a balance and a spring of steel would lose 6 minutes 25 seconds upon a rise of temperature of from 32° to 100° , under the same conditions a gold spring would give a loss of 8 minutes 4 seconds, a spring of palladium 2 minutes 31 seconds, and a spring of glass a loss only of 40 seconds. The chronometer with the glass spring excited some curiosity at the time, and provision being made for its compensation, it was tried at the Royal Observatory for a period of about nine months. As I believe it to be the only instance of a glass spring ever having been applied to a chronometer, its mean daily rate whilst there may be of interest. 1833: November, + 0.6 seconds; December, + 2.0 seconds. 1834: January, + 2.2 seconds; February, 2.0 seconds; March, 1.9 seconds; April, 2.7 seconds; May, 2.7 seconds; June, 3.3 seconds; July, 4.0 seconds. Palladium springs, after being neglected for so many years, are now again coming into use.

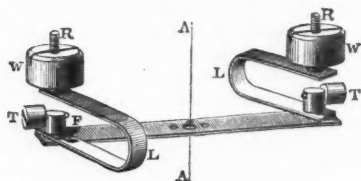
If you open a chronometer which has attained a high position on the Greenwich list, you will probably find that it has a balance of very different appearance to that shown in Fig. 2. As chronometers became more perfect, and the ranges of temperature to which they were exposed became more extended, a curious error began to show itself. It was found that a chronometer which was timed to go right at temperatures of 90° and 60° would, if subjected to a temperature of 32° , lose some 4 or 5 seconds a day. This error, which is called the secondary error, is chiefly to be ascribed to the fact that the moment of inertia of the balance varies, not as the distance, but as the square of the distance of the weights from the centre. Suppose the compensation weights to move over equal increments of radial space for equal increments of temperature, and let us assume the

radius of the balance at a temperature of 90° to be unity, and at 60° , $1 + x$, and at 30° , $1 + 2x$. Then the moment of inertia of the balance (that is to say, its controlling power as to time upon the spring) at the three temperatures, 90° , 60° , 30° , will be proportional to the squares of the above, viz., $1 + 2x + x^2$, and $1 + 4x + 4x^2$. But if we grant (as must be nearly the case) that the elasticity of the balance spring varies with the temperature, then the above expressions ought to be in arithmetical progression, which we see they are not, for the last of them is too big by $2x^2$; that is to say, the moment of inertia in the cold is too great, and the chronometer will go slow, as I told you.

Moreover, if you will give the subject a little thought, you will see that this error of losing in the cold may be varied in two different ways. For, if the chronometer be going slow in the cold, you can put the compensation weight back on the rim of the balance until it goes right. But by doing this, as it was right in the heat before the weight was moved, you will cause the chronometer to lose precisely as much in the heat as it did in the cold. Or, a third course would be to put back the weight half the necessary distance, and then the error will be divided one half in the heat and one half in the cold. What is really wanted to correct the error is a balance that shall move faster inwards than it does outwards, or, at any rate, shall move more weight inwards than outwards. There seems to have been no successful attempts towards such a balance until the year 1840. In that year Molyneux took out a patent for a balance, the same in principle as Fig. 2, but having a little carrier inside the rim. In the heat, when the rim moved inwards, it picked up the carrier and took it along with it, but when the rim moved outwards it left the carrier behind, thus more work was done (from mean temperature) for an increase of heat than for an increase of cold. When Molyneux announced his patent it turned out curiously enough that a certain chronometer maker, named Eiffe, had had under trial at Greenwich a chronometer with a precisely similar balance. As Molyneux had secured the patent, the Government, at the recommendation of the Astronomer Royal, rewarded Eiffe with the sum of 300*l*. The obvious objection, in theory, that this arrangement is discontinuous in its action, does not seem to be supported in practice, and it is the father of many modifications.

The first continuous secondary compensation-balance was Dent's, patented in 1842, and this consisted of a flat bar, composed of steel above and brass below, with two loops or staples mounted upon it for the secondary compensation (see Fig. 4.)

The function of the main bar FB was to accomplish the primary compensation, by tilting the weights WW to or away from the centre, after the manner of one of Arnold's in 1821. The secondary compensation was effected by the two loops LL, which were also composed of brass and steel united; and in the heat, these raised the compensation weights, so that they advanced more rapidly towards the centre, and in the cold they depressed the weights so that they moved more slowly from the centre. Thus the action of the main compensation was in-

FIG. 4.¹

creased in the heat and diminished in the cold. In this way the secondary compensation was accomplished.

Another form of continuous balance (see Fig. 5) was patented by Loseby in 1852. In this, thermometer tubes were fitted to the ordi-

FIG. 5.

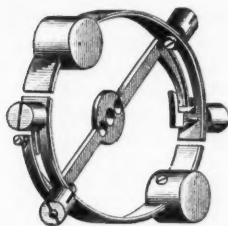


nary form of balance, and the tubes were so curved, that in the heat the mercury tended to approach the centre with greater and greater rapidity.

Another principle of secondary compensation is that adopted by Poole, and in this case the action of the rim outwards is checked by a screw, and in Fig. 6 is seen a modern adaptation of this principle by Kullberg. In Hartnup's balance the central "Arnold" bar is inverted, and there are two other compound bars to increase the secondary action upon the rim, the latter being bevelled to an angle of 45° . In Kullberg's flat rim balance there is also an inverted Arnold bar, and the flat rims perform the same functions as the loops in Dent's balance do. In these days there are many other forms of balances, indeed, every maker of eminence may be said to have one of his own, but they are mostly modifications of the above. Indeed, the Arnold bar, so frequently repeated, seems itself to be a modification of a balance of Hardy's, in 1804. In all these compound lamina, the brass being the weaker metal, is made thicker than the steel, from 2 to 1, to 3 to

¹ For Fig. 4 the Institution is indebted to Mr. Buckney, and for Figs. 5 and 6 to Messrs. Cassell & Co.

FIG. 6.



2, being usual proportions. Although much thicker than the balance spring, the lamina follow a change of temperature with great rapidity. On one occasion, in order to test this, a chronometer was suddenly removed from a temperature of 105° , into a temperature of about 28° , and, after two hours' interval, the difference in time amounted to no more than 0.3 seconds. After a few years' action the lamina often seem to acquire more flexibility, and, therefore, in new work, it is desirable to leave the compensation, if anything, a little slow in the heat.

Methods of Rating.

The first annual trials of chronometers were commenced at the Royal Observatory in the year 1822, and to stimulate improvements rewards of 300*l.* and 200*l.* were offered respectively, for the two best chronometers of each year. Afterwards, the rewards became, 200*l.*, 170*l.*, 130*l.*, for the three best chronometers of each year.

The method by which the chronometers were classified was as follows:—The chronometers were compared every day, and at the end of each month the daily rates during that month were added together, and an average obtained by dividing by the number of days in that month. Then at the termination of the trial the difference between the greatest and least monthly average was sought out, and this difference was called the "extreme variation." The difference between the greatest and least daily rate in each month was also sought out, and the average of these for the total number of months was obtained. After the "extreme variation" had been multiplied by two, this latter average was added to it, and the sum of the two gave the position number. Of course the smaller the number the higher the position was that it gave. The following table, giving the results of these trials, may be of interest:—

Year.	Trial number.	Extreme variation.	Temperature.
1823	11.29	3.86	25° to 80°
1824	4.4	1.1	34 " 70
1825	5.4	1.8	36 " 70
1826	2.6	0.6	25 " 82
1827	4.6	1.5	29 " 79
1828	4.4	1.4	35 " 78
1829	2.2	0.5	29 " 73
1830	3.5	0.9	28 " 80
1831	2.9	0.7	27 " 78
1832	2.8	0.6	39 " 78
1833	3.1	0.8	37 " 77
1834	4.2	1.2	40 " 81

As you may see from the temperatures given above, chronometers were at that time only exposed to natural ranges of temperatures, and it was not until about forty years ago that artificial heat was made use of in testing them. On the other hand, chronometers are not now exposed to the severity of out-of-door cold as they were then; and of late years even the milder practice of opening the windows of the chronometer room in the winter has been abandoned. In these days chronometers are tried at Greenwich in a receptacle called an "oven." The oven is heated by gas, and there is an automatic governor to control the temperature. In addition to the ordinary registering thermometer an instrument called a chronometrical thermometer is made use of. Supposing the range of temperature indicated by the registering thermometer to be 95° to 100°, one might wish to know whether the temperature had been mostly at 95° or mostly at 100°. Without exactly answering the question in terms, the chronometrical thermometer will tell us the amount of the temperature as distinct from its range. The chronometrical thermometer is really a chronometer, the balance of which is compensated the wrong way so as to magnify the change of temperature which an uncompensated watch would show. I will give an illustration of its use from the Greenwich trial of 1888 to 1889.

During the week July 14 to 21 the mean temperature according to the thermometer was 62.2°, and the chronometrical thermometer lost 129.4 seconds; but during the week July 28 to August 4 the mean temperature according to the thermometer was 61°, and the chronometrical thermometer lost 150 seconds. It is evident that despite the reading of the thermometer the latter was a warmer week than the former, because the chronometrical thermometer lost nearly eleven seconds more.

The chronometrical thermometer is timed to go right at 60°, and it accompanies the chronometers throughout their trials. The number of chronometers annually entered is about forty-five, and their trial in general lasts twenty-eight weeks. The trial used to commence in

January and terminate in August, but it now commences in July and ends in January. It will be instructive to follow the course of one of these trials, say that for 1887-88, which commenced on the 2nd of July.

For the first six weeks the temperature was tolerably uniform, the thermometer averaging 70° , and the weekly loss of the chronometrical thermometer being about 540 seconds. The seventh week was colder, the best indication of this being in the record of the chronometrical thermometer, which lost only seven seconds, whilst the mean of the thermometer was 63° . (I am not troubling you with the tenths of seconds or fractions of degrees.) The chronometers were now for the first time put in the oven, and remained there for a month, the average temperature being 94° by the thermometer, and a weekly loss of 2,650 seconds by the chronometrical thermometer. By this time the weather was growing colder, so that on their removal from the oven the chronometers experienced a sharp fall in temperature, the thermometer giving 59° and the chronometrical thermometer 278 seconds fast for the week which followed. The chronometers now remained in the natural temperature of the chronometer room for a period of six weeks, the temperature of the last week being 58° by the thermometer and 783 seconds fast by the chronometrical thermometer; they were then again placed in the oven. A further month in the oven ensued, the average of the thermometer being 94° and that of the chronometrical thermometer a weekly loss of about 2,700 seconds. The week in the last oven happened to be the hottest, the average of the thermometer being 99° and of the chronometrical thermometer a loss of over 3,000 seconds, and upon removal the chronometers again experienced a sharp fall in temperature, the first week out of the oven the thermometer giving an average of 53° and the chronometrical thermometer a gain of 869 seconds. The chronometers now remained in the natural temperature of the chronometer room until the termination of the trial, which took place on the 21st of January, seven weeks afterwards, when the average of the thermometer was 48° and the weekly gain of the chronometrical thermometer 1,272 seconds. There are no rewards now offered for chronometers at Greenwich, but a few of the best instruments which head the list are annually purchased for the use of the Navy. Permission to enter chronometers must, in the first place, be obtained from the Hydrographer, and makers of repute are generally allowed to send two. The method of classification which is adopted is as follows:—The daily rates of each chronometer are added together so as to form weekly rates, and it is only the weekly rates which are printed. Then, at the termination of the trial, the greatest difference which can be found between any two weekly rates of the same chronometer is sought out, and we will call this difference *a*. Again, the greatest difference between any one week and the next following is sought out, and this difference we will call *b*. Then the position number is obtained by adding *a* to *2b*, and it is evident that the smaller it is the better for the chronometer. The reason that *b* is doubled is that a sudden variation between one week and the next

following is a much more serious defect than an error which has been gradually accumulating.

The first table of the Greenwich list gives the rate of each chronometer in the legitimate order of time in which it was taken. But on the succeeding page the rates of the chronometers are arranged in order of temperature as determined by the chronometrical thermometer. The object of this most useful arrangement is to enable errors of compensation to be tracked out with ease and certainty. It is astonishing with what regularity the rate of a chronometer, which presents the most perplexing discrepancies when read from week to week, will sometimes arrange its rate when read in this order of temperature as determined by the chronometrical thermometer. In point of fact, the chronometer itself might sometimes be used as a chronometrical thermometer. Plenty of illustrations of this can be found in the Greenwich list, and if you will divide the errors of the chronometrical thermometer by a fixed number so as to approximate them to the errors of the chronometer, and then deduct the one from the other, you will find what the chronometer might have been but for the oversight of the maker. Indeed, the Greenwich list, though it may seem to the uninitiated but a mass of figures, is most interesting and instructive reading. Look at the first and last weeks of each list and you will see how large a proportion of the instruments continue to be afflicted with the error of acceleration, that tendency to gain upon the rate which I told you of. Again, you may find examples of chronometers which "trip," in which the escapement fails, and the time of which advances by fits and starts some seconds. In many of the chronometers the balances get a "set" on coming out of the oven, and then the rate is permanently changed. In other chronometers the oil may run away, and then the rates of such become very unsettled. This question of the oil is a real difficulty to chronometer makers. To begin with, the oil has to be exceedingly fluid, otherwise it would congeal in cold weather, and it follows that unless very little is put there may be some difficulty in retaining it at the points of the pivots, for the pivots being coned the oil has a tendency to creep up the cone, and you may often notice the effect of the shifting of the oil on the rate of the chronometer in high temperatures, even when the oil does not permanently run away. It is therefore not at all desirable that chronometers should be subjected to high temperatures immediately prior to going on a voyage, and every chronometer which is purchased at the annual trial has to be cleaned and re-oiled subsequently by the maker.

I have made the following comparison of the average position number of the first ten, and of the whole of chronometers on trial at Greenwich for certain years; and add the temperatures, as they may be interesting.

Year.	Average position. Number—First ten.	Average position. Number—Whole.	Temperature.
1868	23·7	52·6	36° to 96°
1869	20·9	41·8	39 „ 100
1870	24·6	—	33 „ 95
1874	24·4	—	36 „ 96
1875	23·3	53·0	40 „ 92
1880	30·2	54·5	24 „ 104
1881	27·4	56·4	31 „ 106
1884	24·0	—	44 „ 105
1885	25·2	44·5	41 „ 106
1887-88	24·5	45·0	37 „ 99
1888-89	18·5	45·7	41 „ 98

I will now briefly describe to you a method of rating chronometers which has been invented and developed by Mr. Hartnup, Chief Astronomer of the Liverpool Observatory, which seems to be of extraordinary power and utility. The Liverpool Observatory is the property of the Mersey Docks and Harbour Board, and great numbers of chronometers are brought from the mercantile marine to the observatory for the purpose of being rated. Most of these chronometers have naturally no secondary compensation, and in many of them the primary compensation has either never been adjusted with care, or else has got out of order by lapse of time. Mr. Hartnup's method is to try these chronometers in three definite temperatures for five consecutive weeks in the following order of temperature: 55°, 70°, 85°, 70°, 55°, and his object is to provide data for the calculation of their rates at other temperatures. Moreover, it is evident that the changes of temperature being systematically arranged so as to return to the same temperature after a given interval enable one to distinguish whether the change of rate, if any, is due to change of temperature, or to some other cause. Now you will remember when I was speaking of the secondary error, I mentioned that it could be so divided as to leave the chronometer losing in the heat and losing in the cold; or as Mr. Hartnup puts it, there exists for every chronometer a temperature on either side of which the chronometer will have a tendency to lose. From the data which he obtains by rating the chronometers as above, and by a series of equations, Mr. Hartnup is enabled to find T , the temperature on either side of which the chronometer will lose; R , the rate of the chronometer at that temperature; and C , the co-efficient which when multiplied by the square of any number of degrees from T gives the amount of loss for that number of degrees. I give the following example from Mr. Hartnup's report:—

Mean Daily Rates.

	55°.	70°.	85°.
	s.	s.	s.
Chronometer A.....	-3·0	-2·0	-3·1
" B.....	+3·7	+1·3	-2·2
" C.....	-3·5	+0·2	+2·2

You see that chronometer A loses equally on each side of 70°, and is therefore well adapted to ordinary voyages. Chronometer B has all its error slow in the heat, and according to calculation would be most suitable for use in a temperature of 9°. Whilst chronometer C having all its error in the direction of the cold would be best adapted for use in a temperature of 104°. From data obtained from comparison of upwards of 1,000 chronometers, Mr. Hartnup has found an average value 0·0025 for the co-efficient C, but of course C varies for each particular instrument. By the methods above stated it is within Mr. Hartnup's power to assign rates corresponding to different temperatures, and in practice the navigator would consult his thermometer and then add the corresponding rate. The following is an example of such a rate:—

Rates to be added according to Temperature.

	s.		s.		s.
45°	+2·2	65°	+3·7	85°	+3·3
50	+2·8	70	+3·9	90	+2·9
55	+3·2	75	+3·8	95	+2·3
60	+3·5	80	+3·6		

The exactitude with which chronometers follow the rates which have been forecast for them is very surprising. And Mr. Hartnup, in his report of 1883, compares the performance of the chronometers of the Pacific Steam Navigation Company with the performance of the chronometers on trial at Greenwich, the changes of temperature experienced by each being very similar. I am sorry I have no time to follow Mr. Hartnup through his most interesting remarks, but breaking up the chronometers into three divisions he arrives at the following result:—

In the case of the Pacific Steam Navigation Company, average difference of daily rate between one voyage of 105 days, and the next following of the same length—

One-third best.	One-third second best.	One-third worst.
0·14 second.	0·31 second.	0·66 second.

In the case of the chronometers at Greenwich average difference of daily rate between the first and second 98 days of trial in the year 1880—

One-third best.	One-third second best.	One-third worst.
0·88 second.	1·25 second.	1·96 second.

You see that the chronometers rated upon Mr. Hartnup's principle have by far the best of it; and although the year 1880, at Greenwich, was rather a poor one, it is evidently not sufficient to account for the difference, nor to invalidate Mr. Hartnup's comparison to any sufficient degree. I may add that Mr. Hartnup's system is now employed by the Government of the United States, and also at the Kew Observatory, where chronometers can now be rated and certificates obtained.

I must not close this paper without speaking a word upon the subject of magnetism. The effect of magnetism upon a chronometer is disastrous, and when once thoroughly imparted it is almost impossible to remove magnetism. A portion of the trial of each chronometer at the Royal Observatory is devoted to trying it with the 12 o'clock placed in turn towards each quarter of the compass. In general, chronometers so rated there are not found to be affected by magnetism, but it is a question whether the same would hold good for chronometers placed on board a modern war vessel, where electrical appliances are so abundant. Had I had time, I should much have liked to have compared some of the sea-going rates of chronometers under such conditions with the rates issued on shore. It is very possible that in the not very distant future ships' chronometers, like the watches used by electrical engineers, will have to be rendered "non-magnetisable."

Captain WHARTON, R.N., Hydrographer to the Navy: Mr. Chairman and Gentlemen,—I think the Institution is to be congratulated on the possession of such a valuable paper as Mr. Gardner has given us. It contains an extremely lucid *résumé* of the whole history of chronometers, and, as far as I can judge, it leaves out nothing; it is not at all easy to find anything to remark about, the paper being mostly a store of facts which Mr. Gardner has selected for our benefit; it is not until we come to the end of the paper we find anything to raise discussion. I gather that Mr. Gardner favours Mr. Hartnup's method of rating as compared with the method in use at Greenwich. In the abstract, I quite agree with him; but I should like to say I think the objects which Greenwich and which Mr. Hartnup have in view are entirely different. At Greenwich a considerable number of chronometers are sent for testing, and the Admiralty select those at the head of the list, provided that they come up to a certain standard of excellence. Those chronometers are so well compensated that the question of temperature is entirely swamped in the accidental variation to which the chronometer is liable by the vibration of the ship, and so on. I think that all naval men will agree that we do not find any inconvenience whatever in having no temperature compensation to add to the observed rate. I think the best test of that is shown in the way in which the longitude can be found throughout the world. Of recent years, as we all know, submarine telegraphs have been extended far and wide, and the longitude of different ports has been determined with very great accuracy; but in no case has an error of more

than half a mile been found anywhere throughout the world, except in one place, and the very last place you would have thought of, namely, Lisbon. Lisbon is, I think, three miles out. Take a place like the Straits of Magellan, Sandy Point. This has not indeed been connected by telegraph the whole of the way, but the telegraph is taken to Monte Video, whence a number of runs with a very large number of chronometers were made a few years ago in connection with the Transit of Venus, and it was found that the determination of longitude was exactly the same as Captain Fitzroy's determination made over sixty years ago. Therefore, practically when looked at from a chart-making point of view we have not lost anything by not having this temperature correction. Mr. Hartnup's method has been adopted, of course, because the majority of chronometers in merchant vessels have not the secondary compensation, or are imperfectly compensated; but comparing the statistical records of Mr. Hartnup's observatory with Greenwich, it is just as well to make these few remarks. I should also be glad if Mr. Gardner would tell us whether he has taken the whole of the chronometers rated at Greenwich for one year as against how many of the Pacific Navigation Company. It would be interesting, I think, for the Institution to know that point. We have a very large number of very old chronometers in the Service. We have gradually bought a few at a time, following the principle that we only buy the very best chronometer that the makers offer in the year, and the result is that we have chronometers fifty and sixty years old still going on our ships, though I am bound to say a great many of them give us a deal of trouble, and a good many have now to be condemned every year, because their repairs are getting so expensive and troublesome; but it was only last week, in a report from one of the surveying vessels on her chronometers, that a very laudatory account was given of one particular chronometer, and when we came to look at it, this chronometer was made in 1825! That shows what a chronometer will do when it is originally made with great care.

Admiral Sir GEORGE WILLES: In what year were chronometers introduced into the Navy generally?

Captain WHARTON: In about 1825.

Admiral Sir HOUSTON STEWART: As to the date when chronometers were supplied to the Navy, I should like to make one remark:—In 1805, my father was a midshipman in the "Medusa," Captain Sir John Gore, when taking the Governor-General, Lord Cornwallis, to the East Indies. The ship had then no chronometer. There was a mate, what we now call a sub-lieutenant, a past midshipman, on board the ship, who had a wonderful knack for taking lunar distances; he could not be depended upon to make the calculations, but he could take the distance with wonderful approximation to accuracy, and he did so throughout the whole of the voyage. The ship was navigated to India with these lunars in 1805. In 1817 my father commanded a 16-gun brig in the West Indies; he had not a Government chronometer, but had a chronometer of his own. On one particular occasion he went away on an expedition to Vera Cruz, and by some omission, in his absence, the chronometers were not wound up. When at sea he could not get any lunar observations for some time. They were running with a fair wind, going by dead reckoning, and when one night he succeeded in getting a lunar it was found that they were running upon a dangerous shoal. On that lunar observation they altered their course in time and saved the ship. He took great care that his chronometers should never be allowed to run down again. Such things, we know, cannot happen in the Navy now, because we take such precautions that the chronometers cannot by any possibility be forgotten, for the marine sentry who is in charge of the Captain's cabin is not relieved until the chronometers are wound up. There is a printed board, having on one side, "Chronometers wound up," and on the other side "Chronometers not wound up," so that all who run may read. This board is turned when the sentry is relieved at 8 p.m., and if any one saw the board in the morning indicating that the chronometers were not wound up, timely attention would be called. We have listened to a most interesting and instructive lecture, clearly delivered.

Admiral Sir GEORGE WILLES: Although chronometers were generally introduced in 1825, only one was supplied by the Admiralty, and if the Captain found

one of his own, then a third was given, and this system was continued up to within the last few years; perhaps it has been altered during the reign of my friend?

Captain WHARTON: I think that has been abolished long ago.

Admiral Sir GEORGE WILLES: I have in my pocket a watch-chronometer by McCabe, purchased in 1833, by Admiral Sir James Hope, when he commanded a brig, which enabled him to claim two for his ship. Sir James Hope gave the watch to me when I ceased to be his Captain.

Mr. W. ELLIS, F.R.A.S., Royal Observatory, Greenwich: I think we should be very much obliged to Mr. Gardner for the capital account that he has given of this subject. It forms part of the larger question of the improvements made in the method of determining longitude at sea. I think the debt which British commerce and the Navy owe to astronomers and to horologists is sometimes, perhaps, not quite realized. Two hundred years ago there was no sufficient method of finding a ship's position at sea as regards longitude except by the dead reckoning. Even in the middle of the last century Commodore Anson, in his celebrated voyage round the world, had no better means. When he rounded Cape Horn he unexpectedly made the land on the western side, and found himself in consequence 300 miles more to the east than he expected, and so his voyage was delayed. Then, again, he wanted to make the Island of Juan Fernandez to recruit the crew. He got into the latitude of the Island and thought he was to the west of it, but he was really to the east; he ran eastward and made the mainland of America, and turned round and had to sail westward again, and at last got to the Island, losing many days, and during that time many of his men died. These kinds of things were not exceptional, they were constantly occurring. Greenwich Observatory was founded to help to remedy these defects. The instruction to Flamsteed was to rectify the tables of the motions of the heavens and the places of the fixed stars. Flamsteed made a large star catalogue, and many observations on the moon and other bodies, and the results of his lunar observations were taken in hand by the philosophers of the time, Newton and others. The construction of lunar tables was a very serious matter, and to predict the place of the moon with sufficient accuracy for the adoption of what is called the lunar method of longitude was the problem to be solved. The lunar method is this: the moon moves so swiftly from night to night through the sky that she shifts her position with respect to the stars very rapidly, and if the sailor be provided beforehand with a book giving the distances of the moon from certain fixed stars for certain hours of Greenwich time on every day of the year he can, in any position in which he may be, by observing the position of the moon, ascertain the Greenwich time. It was not, however, until the year 1767 that Maskelyne, a succeeding Astronomer Royal, founded the "Nautical Almanac," and gave therein, for the first time in any country, such distances of the moon from certain fixed stars, lunar distances as they are called, that the lunar method came into use; but in the meantime improvements in timekeepers had been going on; Harrison had invented his chronometer and received his reward, but Arnold and Earnshaw afterwards made such further improvements as to bring the chronometer really almost into the state in which it is now, and since about the beginning of this century the chronometer method has gradually superseded the method by lunars. But in the "Nautical Almanac" the lunar distances are very wisely still retained, because a chronometer may accidentally run down or stop, and any man provided with a "Nautical Almanac," a sextant, and an ordinary watch can find his position independently, or can set the chronometer right, as the previous speaker has said, by lunars. The Navy chronometers were, I believe, brought to Greenwich Observatory about the year 1821, though perhaps there had been chronometers belonging to the Navy before that time, and during the period since elapsed, annual trials have been made at Greenwich of chronometers sent in by chronometer makers excepting in one or two years. These trials, I believe it is allowed, have much improved the construction of the chronometer. I had myself the personal superintendence of chronometers for twenty years at Greenwich, and I noticed the gradual improvement during that time. I believe that improvement has gone on, though others can speak of it better than I can. Sir George Airy and the present Astronomer Royal have paid great attention to this department of observatory work. I should say that the Astronomer Royal wished me to mention

that in consequence of being compelled to attend the Royal Astronomical Society to-day, it being the annual meeting, and he being the President of that Society, he has not had the pleasure of being here.

Lieutenant-Colonel BAYLIS, Q.C. : I am glad to be present and to have heard this lucid descriptive paper on a subject which is before us daily, but which perhaps we have least understood. We know that in the present day a watch is to be found in almost everyone's pocket, yet, I suppose, there is no instrument, the history, the mechanism, and construction of which are less understood than that one, the principles of which have been laid before us this afternoon in a manner at once so clear and instructive. I daresay that hardly one person in a dozen understands the principle upon which the mainspring of a watch acts, and how its force is kept in check, as shown to us most clearly to-day. Then, again, many have never heard of the way in which the compensation balance is now contrived so as to counteract the changes of temperature. That has been explained to us to-day in a way that I never myself have seen before. We have, of course, heard of the different metals, that brass is the more expansive metal than steel under heat, but how they were brought into use, and how the compensation or adjustment was produced by fastening strips of brass and steel side by side, the one pulling against the other according to the constant variations of the temperature, I have never before been able to realize. I am only speaking plain things perhaps, but I am sure many of you present will appreciate my remarks. It is an every-day subject which we knew very little about, but we shall go away now conscious that we have learned much with regard to these things, which have been brought to our minds in so simple a manner. I am glad to see Captain Cook's chronometer on the table.

Mr. GARDNER : It is very similar to Harrison's.

Lieutenant-Colonel BAYLIS : I see towards the end of his lecture Mr. Gardner says : "Had I had time I should much have liked to have compared some of the sea-going rates of chronometers under such conditions with the rates issued on shore." Anything coming from Mr. Gardner would be very much appreciated if he would give us a second lecture upon a subject which I am sure would be capable of expansion under his hands.

Admiral COLOMB : I feel myself an example of virtue rewarded. I came to the Institution entirely on duty, and though I do not mean to say that I am exactly one of those "who came to curse and remained to pray," I certainly came here to be bored, and remained to be delighted. I only wish we had had a larger audience to have heard the paper, beautifully put together as it is, so clearly read, and with the by-illustrations so very well carried out. The early historical part is a good deal in my line, and I can confirm much that was said about the older difficulties of navigation without a chronometer, for I have to burrow a good deal amongst the old logs of Her Majesty's ships, and I cannot imagine any better study for the modern naval Officer if he wants to understand his present position than to do a little of that burrowing. The astonishing recklessness, as we should now call it, with which our forefathers were obliged to carry out their navigation in the absence of chronometers is quite startling as you turn over page after page of those books. The longitude depended absolutely on dead reckoning, and you seldom come across in the older logs any records of longitude by observation. The longitude was carried on from point to point, so that it was impossible to say at the end of a long voyage what amount of error might not be picked up. A ship would sail from Plymouth and take her longitude from Greenwich first. When she got to Madeira she would take her longitude from the assumed longitude of Madeira ; when she got to the Western Islands she would again take her longitude from the assumed longitude of the Western Islands and so on, so that they had the chance of an accumulated error according to the chance of the positions she went from being badly fixed. You get another excellent method of understanding what the chronometer has done for us if you look at some of the old signal books in this Institution. It was, of course, the practice to send ships ahead of the fleet to pick up the land, and guard the fleet from running ashore, and you would have supposed that the signals provided to the ships ahead would have given some definiteness to their capability of expressing what land they saw when they made the signal for seeing the land, and for what land it was. But if you look at the signal books you see

that the possibilities of report generally embraced some hundreds of miles; for instance, you might have a signal for seeing the land from Scilly to the Lizard, and another from the Lizard to Portland. They were perfectly happy to get the land within a range of 300 miles. Sir William Monson has some very nice remarks on the navigation of his day, as to the error of longitude and the impossibility of getting the thing right. I think he says that the masters of the fleets that he has been in, going from Plymouth to the Western Islands, were very happy indeed if they hit them off to some scores of leagues. As to the mechanical arrangement of the chronometer, I agree with Colonel Baylis' expressions of pleasure with the beautiful and careful description which have been given to us. I think we shall all be able to carry away a clear idea of how the thing is got at, and a much clearer idea of the enormous amount of perseverance and intelligence which has been bestowed in order to produce the beautiful instrument that we now rely upon without the slightest hesitation. I am not sure that I followed the lecturer accurately, but there were one or two expressions which, as far as I made out, want a little further explanation. I did not catch exactly what the *remontoire* meant, and the preference of a white balance spring to the blue, I think also wants explanation. There is also the word *palladium*; I did not quite gather what it meant. The term "position number" is also a little puzzle to me.

Sir HOUSTON STEWART: The lecturer has told us that Harrison made his experiments in 1761, and that on the trial voyage in the "Deptford" to Madeira and Jamaica in that year, and afterwards in the "Tartar" with Captain Lindsey in the year following, the chronometers were found to be so reliable as to be reported perfectly successful. I understand that the variation for the whole voyage was 50 seconds, or something of that kind.

Mr. GARDNER: One minute 54 seconds.

Sir HOUSTON STEWART: The chronometers were thought quite successful?

Mr. GARDNER: Yes.

Sir HOUSTON STEWART: Still, they were not adopted in the Navy until well on in 1825. Can Mr. Gardner tell us from his knowledge of the subject whether it was considered that there was any fault in Harrison's chronometers? I know that the trials to which I have referred were considered to be successful; Harrison said that they would see the land at a certain time, and they made it exactly. The weather had been very bad, and yet the going of the chronometers was perhaps as good as it is in the present day.

Mr. ELLIS: I think the point is rather that there was at first difficulty in constructing these instruments, because when Harrison made his chronometer, I believe he could not claim the reward until it could be shown that another man could make one like it, and one was so made.

Mr. G. J. SYMONS: There are two small points on which I should like to say a word. I need hardly say I am not an expert in chronometers at all. I came here only to learn, and I have learned one point with respect to the chronothermometer. I should like to know whether it is possible to add to its use a thermograph, because I think that the thermograph would be a very valuable addition. The other point is with respect to the Messrs. Hartnup. It would be well, I think, to distinguish between the two generations of Hartnup; at the present time we have the son at Liverpool. The father was originally director, and probably made the arrangements described in the paper. I think there should be a distinction.

Mr. T. LEWIS, F.R.A.S., Royal Observatory, Greenwich: Perhaps I can answer the question about the thermograph. We have in our oven at Greenwich a gas regulator made by Kullberg. This keeps the temperature so close, ranging about 3° in a week, that the thermograph is not necessary. In addition, there is a maximum and minimum thermometer, which is read daily. They have one at Kew. I think there is some mistake about Harrison's third chronometer, or machine for measuring time. It ought to be the fourth. Then I think you may get a wrong idea about the purchase of chronometers at Greenwich. The list Mr. Gardner has taken comprises the whole of the chronometers on trial. Any maker can send a chronometer to Greenwich, whether good, bad, or indifferent. We have several now on trial that we would not think of purchasing. The rates of these are printed with the others, and if averages are taken

with these included, it makes a great difference. We only buy, perhaps, six out of fifty, so that if a comparison be made, it ought not to include other than the best instruments. The Hartnup method is valuable because it may get a good result from a very inferior instrument. But if you can get a good instrument there is no reason why you should take a backward step and have a bad one. These are the weekly rates of the first chronometer on the Greenwich list at different temperatures:—

S.		
0.0	55°	} where + indicates a gaining rate, and — a losing rate.
—0.5	65°	
+0.2	75°	
—1.0	90°	
—0.3	95°	

I do not think there is anything to quarrel with in a chronometer of that sort. We do not want to apply any formula. No mention of deck watches has been made, but they play a very important part in the Navy.

Mr. POOLE: I thought that I should like to speak on this occasion, because I have recently had the honour of being entrusted with that chronometer of Captain Cook's on the table, by the Council of this Institution (at my own request), for the purpose of cleaning and examination. It was made in 1771 by Larcum Kendall, Harrison's apprentice, and outwardly resembles the original instrument for which 20,000*l.* premium was paid by the Government, although its internal construction is much simpler. Mr. Gardner has said that there are means of correcting the daily rate of Harrison's; but this one, which is constructed on the same principles, has a regulator, which acts independently of the "compensation curb." I found it, however, to be difficult to manipulate; in fact, two out of the four weeks that the instrument was in my possession, were spent in endeavouring to bring it to a close rate. The difficulty may have been increased by the condition of the escapement, which is very much worn.¹ But it performed well while used by Captain Cook. As far as I can ascertain, he took no chronometers with him on his first voyage in the "Endeavour" (1768-71). On the second voyage I find that he had this one with him in the "Resolution," and one of Arnold's. Two more of Arnold's were on the "Adventure." On the last voyage, only this one is mentioned by Captain Cook. Two of Arnold's are in the possession of the Royal Society. I have recently examined and cleaned them by permission of the Council, who were aware that I had had this one. I was curious to examine these instruments, because Arnold's name is always associated with the helical or upright balance spring, and the compensation balance, patented by him in 1775 and 1782 respectively. These two² chronometers, however, have plain circular balances, like Harrison's, with flat springs, controlled in temperature by "compensation curbs;" they have a rude form of the spring detent escapement, and beat half seconds. They do not appear to have been used after the close of Captain Cook's expeditions. We have been informed during this discussion that chronometers did not come into general use in the Royal Navy until the year 1825; of course Captain Cook's voyages were made for special purposes: the first being to observe the transit of Venus in the southern hemisphere, and the others (as well as Captain Bligh's expedition in the "Bounty" in 1787) were to follow up, and turn to practical account, the discoveries he then made.

Mr. WHITTAKER: I should like to say one word with reference to chronometers in torpedo boats. The present spring detent chronometers have been found not to perform satisfactorily in torpedo boats, and resilient lever escapements are being made to allow the balance to move more than 500°, as Mr. Gardner points out,

¹ See article on the "Bounty's" chronometer, in the "Nautical Magazine" for 1840, page 901.

² One of these is numbered 3, the other, evidently finished after it, has no number. In the collection of horological curiosities at the Guildhall, belonging to the Clock-makers' Company, there is a chronometer by Arnold, numbered 1, with a helical spring and compensation balance. It may be that the movement had been laid by and then taken up again for the purpose of experiment.

without any variation of rate. It seems to me an important improvement for chronometers. Three of these are being constructed for the torpedo boats of the French Government under the direction of Mr. A. Readier. I have with me a model of the construction, and also the reports of scientists, and, if they are of interest, I shall be pleased to show them to you.

Sir GEORGE WILLES: Can you tell us, Mr. Lewis, whether chronometers are affected in the Arctic regions?

Mr. LEWIS: The chronometers that were sent with the Arctic Expedition were specially compensated for the purpose, but it was found when they got there that they were kept so warm, that this compensation was unnecessary.

Mr. GARDNER: In reply to Captain Wharton, I dare say I did not make the subject quite clear. I did not intend to imply any comparison between Hartnup's method and the annual trial at Greenwich, because they are for two distinct purposes. The use of the annual trial at Greenwich is to select the best chronometer; the use of Hartnup's method is to enable you to make the best use of an indifferent instrument when you have got it. The chronometers sent to Mr. Hartnup are generally supplied with balances of the usual kind, which at Greenwich, I do not suppose would be taken at all. I thoroughly agree in the remark as to the good which has been done by the Greenwich trials; I believe it is impossible to exaggerate the benefit. There has been a spirit of rivalry and competition evoked which has greatly stimulated chronometer makers, and has done a great deal of good. With reference to Admiral Colomb's remarks about the *remontoire*: the *remontoire* is a kind of little watch inside another one. The function of the big watch was to wind up the little watch, or rather little spring, and this spring acted on the escapement. In an ordinary watch or clock you have the friction of all the pivots and bearings, but in Harrison's the part which acted on the escapement was automatically wound up every $7\frac{1}{2}$ seconds, and there was only the friction of the escape wheel pivots to affect the escapement. Then as to the white balance spring. The springs are generally left blue; that is to say, they are made white first of all and then blue, i.e., put under the action of temperature which gives a bluish colour. But it has been found much better to leave the springs white as they are not so readily attacked by rust. Then as to the position numbers, the method by which the position of the chronometer is obtained on the list. For the annual trial at Greenwich you take the greatest difference between one week and any other, and then you double the greatest difference between one week and the next, and add the two together. I have described the method in my paper. Then I think there was some remark as to why chronometers were not adopted in the Navy till so late. Of course Harrison was the only man to make them at first. The trade had really to be found out—to be taught to others. Part of the condition of receiving the reward was that Harrison should instruct others how to do the work. I believe Larcum Kendall's price used to be 400*l.* for each chronometer, and then there was only a handful of workmen who could do the work. Of course they increased in time. I do not think it was till Arnold's time that the trade became general. The deck watch I did not say anything about, because my subject was confined to ships' chronometers. The deck watch is used for the purpose of carrying the time from the chronometer to the deck. It is a very good watch; a pocket half-chronometer. Mr. Poole speaks of Harrison's chronometer having had a regulator. I think he is mistaken, because it was a special complaint of Dr. Maskelyne's that the watch had no regulator.

Mr. POOLE: That one has a regulator.

Mr. GARDNER: But that is by no means a duplicate of the one at Greenwich. The one at Greenwich has a *remontoire*. If you read up old papers of the time you will see it was a special complaint of Dr. Maskelyne, the Astronomer Royal, that the watch had no regulator. He complained of it specially.

The CHAIRMAN: Gentlemen, it is now my pleasing duty to thank the lecturer in your name for the very interesting paper which we have had read to us to-day. When he did me the honour of asking me to take the chair, I felt very diffident in doing so, because there are many present who I should much prefer to see in this position. Like Admiral Colomb, I came here expecting to hear a good deal said which was far beyond me. But the lecture has been rendered so popular, and the

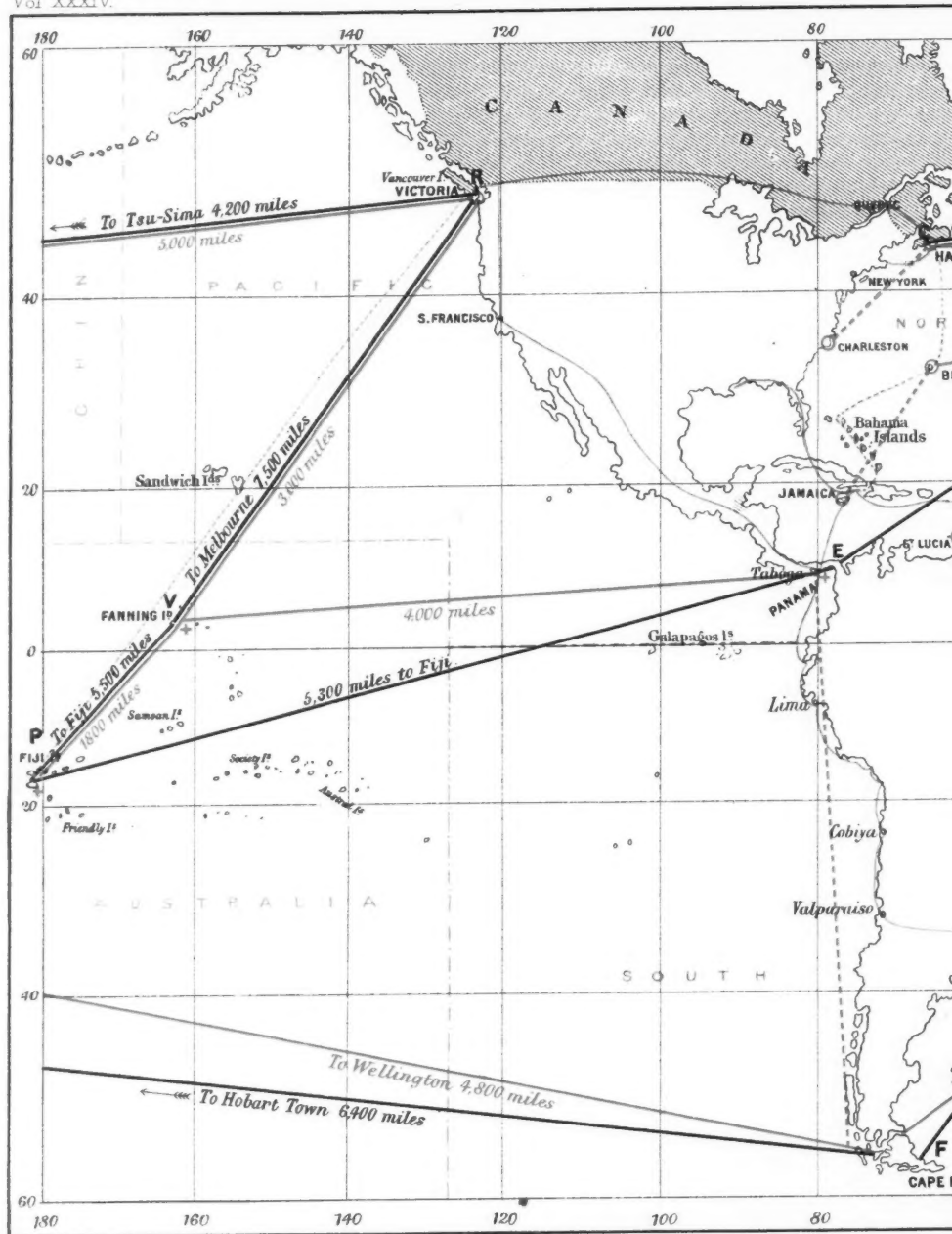
338 THE CHRONOMETER, ITS HISTORY AND DEVELOPMENT.

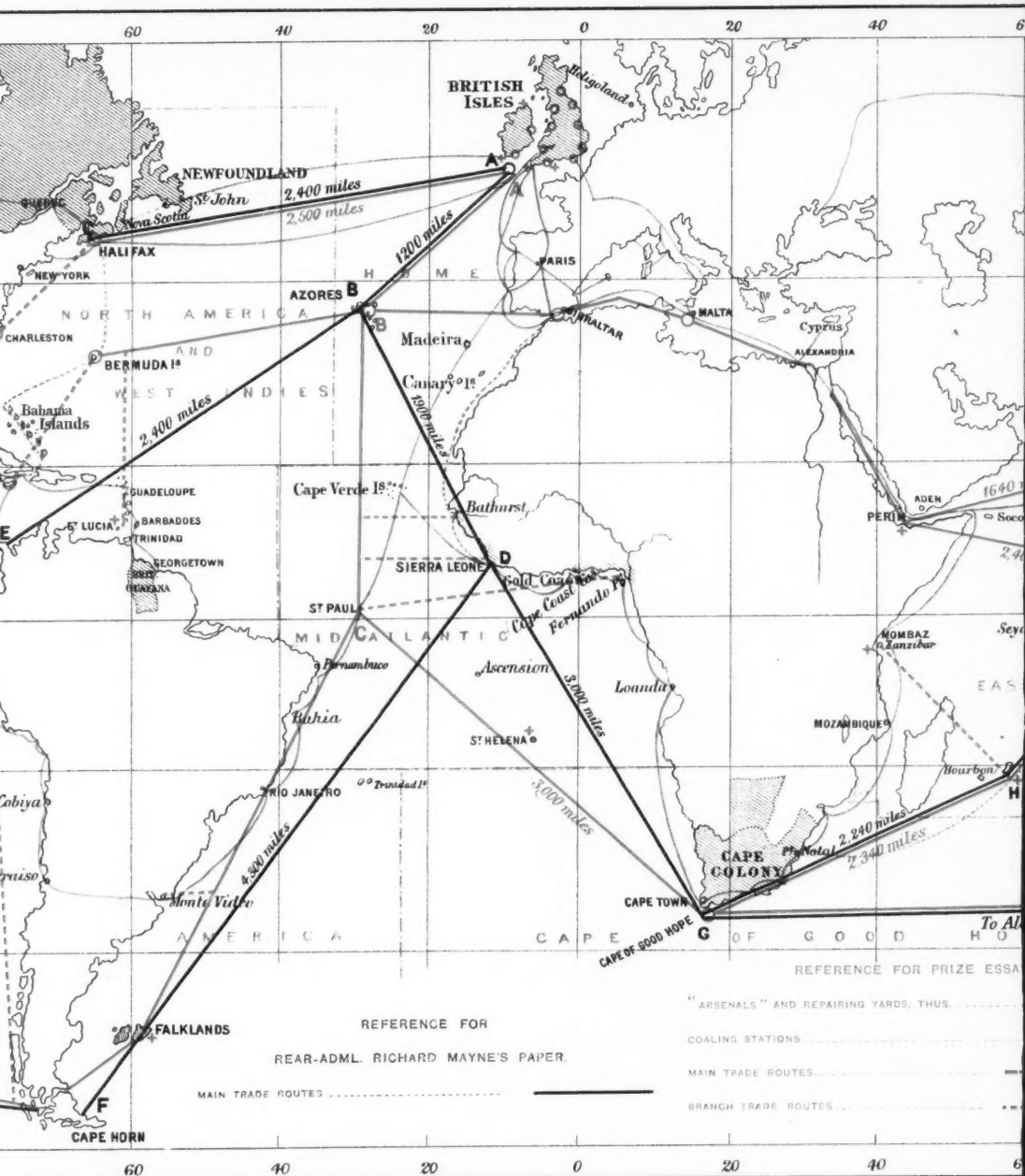
illustrations have been so thoroughly well explained, that I think we shall go away very much wiser about clocks than when we came. Admiral Willes, I think, forestalled me in one remark, viz., that in former days a ship was allowed one chronometer, but if the Captain had something else in the shape of a chronometer (it might not have been a first-class article), he was allowed a second Government one; the idea being that if one went wrong out of two, it would be uncertain which it was, and the third one would decide the point. I remember in my early days as a midshipman I was rather fond of taking observations, and was selected by the then master of the ship to take the time for the sights, and to assist to correct the rate of the chronometers when the ship arrived in port. I used to take a good deal of trouble about observing lunars, and became, for an ordinary Naval Officer, fairly expert at observing lunar distances. But the difficulty with regard to lunars was this: a very small error indeed in the observed distance made a very great error in the longitude. Before the days of chronometers, the longitude of a position on shore was fixed from the results of a series of lunar observations, and was even then scarcely reliable. In these days of almost perfect chronometers, the necessity for lunars has disappeared. I am sure I can heartily thank the lecturer for giving us this paper to-day. He has rendered a technical subject popular, interesting, and useful.

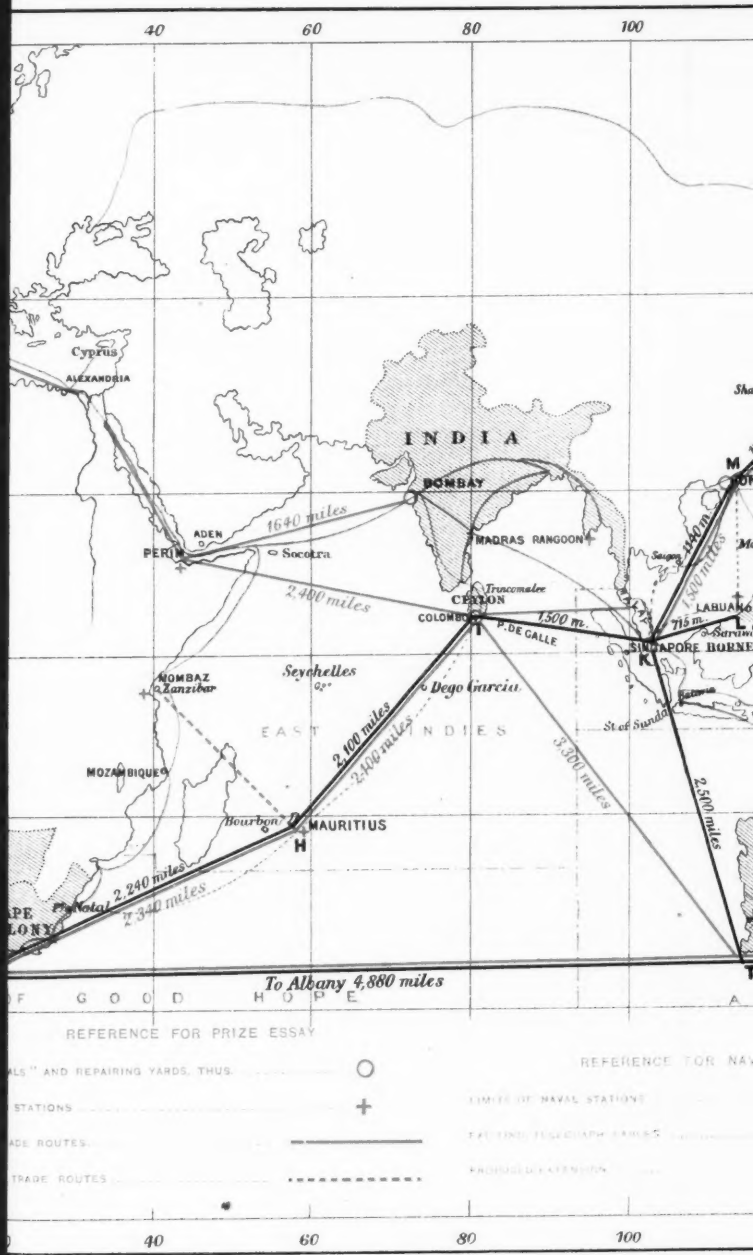
Captain WHARTON: It would be interesting to the meeting to know that at this moment there is at Greenwich the very best chronometer that has ever yet been tested. I had a letter from the Astronomer Royal the other day to say it was undoubtedly the finest instrument he had ever had.

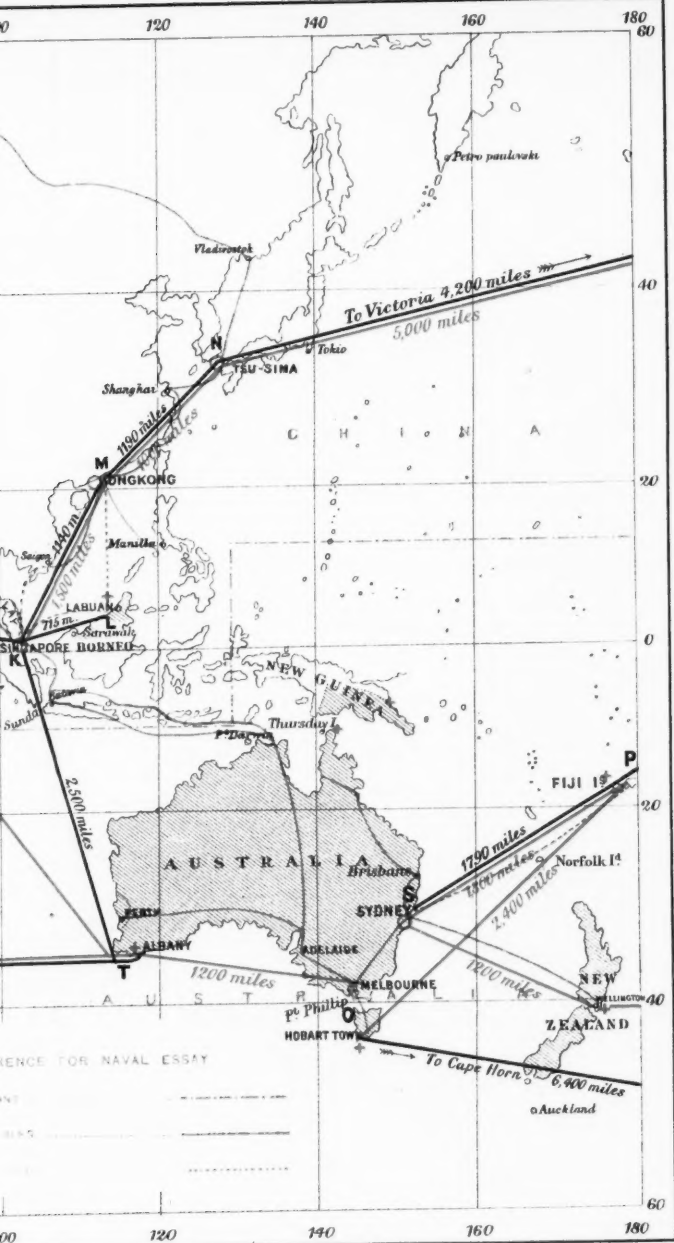
The CHAIRMAN: Is it a very modern one?

Captain WHARTON: Oh yes, I presume of this year's or last year's manufacture.









Friday, February 21, 1890.

ADMIRAL SIR R. VESEY HAMILTON, K.C.B., Lord of the Admiralty, in the Chair.

ON LESSONS TO BE LEARNT FROM NAVAL
MANŒUVRES.

By Rear-Admiral RICHARD C. MAYNE, C.B., M.P.

"Our Country looks to its Sea Defences; let it not be disappointed."—NELSON.

WHEN I was asked by your Council to give this lecture my first impulse was to decline, on the ground of my incapacity to treat such an immensely important subject before a professional audience, with such a knowledge of detail and comprehension of facts as would result either in benefit to the Service or credit to myself; and also from a regard to that proverb of Solomon which I have always held in great esteem, "Even a fool when he holdeth his peace is accounted wise." But all ventilation of ideas however crude, and all discussions on the Navy, do good; and on second thoughts I decided that it would do me no harm, and might be to the benefit of the Service, if I submitted myself as an anvil upon which my brother Officers and others much more competent to treat such a subject, could hammer out more worthy conceptions and more useful conclusions.

Though I hope that at least some of my opinions may find acceptance, it is far more with a view to discussion of the points raised, and eliciting the opinions of others, that I have undertaken the task. There is no pretence of originality, and I look forward with no displeasure whatever to anyone's laying claim to each or all of the ideas set forth. I have freely robbed anybody whom I thought worth robbing, and quoted wherever I thought it desirable from the writings and speeches of those competent to speak on naval affairs. I hope I have abstained from cavilling at or criticizing minor defects where there is a desire to reform abuses. I consider that in this respect great credit is due to the present Admiralty; but, as the Financial Secretary to the Admiralty said quite recently, "Though much has been done, much more remains to do;" and I presume I am addressing those who have no faith in the suggestion made by one of our modern statesmen, "that we should dispense with costly defences

and rely on a substitute of unparalleled cheapness—our undying historic memories;” but who believe that if we are to maintain our position among the nations of the earth we must not relax our efforts, but push forward till we attain the highest possible standard in the construction of ships, guns, and engines, as well as in the training and discipline of Officers and men; that no sum of money which any Government is likely to propose to the House of Commons to grant can be too great to attain these aims, always assuming that such money is spent to the best advantage; and that to be in a state of thorough preparation to defend our rights and Empire is the best way to prevent war, one year of which would in all probability cost more than the whole value of the British Navy—ships, guns, and men put together; in short, that you believe the key to the whole position, the reason for the existence of the Navy at all, the basis of all naval policy upon the correct realization of which depend the number and class of ships, and the number of men and reserves, is that a great Empire must be strong or perish.

The more immediate lessons from the actual Naval Manœuvres, such as have been carried out during the last three years, are in one sense the smallest of those to be learnt, important though they be as part of the whole system. I mean that the part of it comprised in the “mobilization of our Fleet,” and the subsequent handling of our ships together for a certain time at sea, is only a test of what you have got to hand—a test of efficiency of the matériel and proficiency of the personnel of that part of our Fleet which is in home waters—and the result of which has been principally to bring into the strongest possible relief the contrast between our personnel and matériel, showing the great proficiency of the former, especially, I think I may with justice say, as regards all junior Officers and what may be called the “working” part of the Fleet; and, on the other hand, the sad deficiency of most of our ships in those qualities which would be required in actual war—the result of want of continuity at Headquarters in planning and building; of the apparent absence of fixed ideas of what is wanted; of the adoption of the views of foreigners without due consideration; of the endeavour to make one ship answer the purpose of several, and of an unwise parsimony, spoiling a really good vessel by limiting her cost to a certain sum, when a few more thousands—nothing in comparison to the whole amount—would have made her thoroughly efficient, of which the “Admiral” class is a glaring example.¹

The manœuvres, further, lead all concerned to look more closely into the questions of naval warfare. They have brought prominently forward, so far as regards our own coasts, the immense importance of the coaling question; of the efficiency of communication not only between H.M. ships and steamers of the mercantile marine, but also between cruisers and signal stations on shore, both by night and by day; subjects which still require great development. They have also practically proved our deficiency in

¹ I believe I might add the cruisers to this category also.—R. C. M.

Officers of Lieutenant's rank, and in Stokers. They have further demonstrated the inefficiency—I might say the uselessness—of ordinary torpedo-boats as an adjunct to a seagoing fleet, however useful they may be for an attack on a blockading fleet and for harbour defence. They have given Officers more experience of a certain nature in a few weeks than can be obtained by three years on distant foreign stations, and they have tended to bring about, I hope and believe, much closer relations between the Royal and the Mercantile marine, which must be of the greatest value in any future war. These and many other points are brought prominently to the front, among which by no means the least important is that of drawing the attention of the public to the fact of our having a Navy at all! enabling them, to a certain extent at least, to see what it is for which the taxpayer gives his money; and creating a general interest in naval affairs, which is of the utmost importance, both to the Navy and the country generally.

But while these are the lessons taught to Officers in general and to the public, I must presume that they demonstrate no novelties to those who have the responsibility of providing for the naval defence of the kingdom. For, despite the late denial of a very high official of the existence of any such thing as a "Plan of Campaign" at the Admiralty, I must decline to believe that our rulers sit at Whitehall with no idea as to what they would do on the outbreak of war, and with the intention of trusting entirely to the moves of the enemy for their policy and their strategy. If really no such thing exists, and if we are to believe that all our ships, with their precious burdens, are to go into war on the haphazard of the moment, and that no scheme for the protection of our food supply has been authoritatively approved and placed in the hands of the various Commanders-in-Chief, then should our rulers join with the utmost fervour in the prayer for peace, for there must be a heavy day of reckoning for them whenever war breaks out.

In the following remarks, then, I assume the position of "Commander-in-Chief of the Navy." I do not wish to shock anyone's susceptibilities by the title "Commander-in-Chief," for the title is a matter of comparative indifference provided that the principal naval Officer at Headquarters holds the position which is perhaps better expressed by that title than any other; and that being divested of the petty routine work which now occupies almost entirely the time of the "First Sea Lord," he would be able to look into the really important matters concerning the Service. I assume that he has lately come into office, but with a full knowledge of all naval requirements such as an Officer selected for that position should have; and that he sets to work to consider 1st, what he has got in men and material; 2ndly, what is lacking to enable him to defend the shores and maritime interests of the British Empire against any probable combination of other Powers; and 3rdly, whether the administration by which he is surrounded is in all its branches calculated to make the most of the resources of the Empire in this respect. In this task he must have before him various "plans of campaign," based on the

various alliances of other European Powers with and against us; and, as he has the means of knowing precisely the size, speed, and armament of all foreign ships, this is a comparatively simple task as far as the line-of-battle and its accompaniments is concerned, although all naval operations are sufficiently problematical to necessitate the provision of large reserves to meet miscalculations as to the combinations and movements of the enemy, and the amount of loss occasioned to the Fleet by the first general action.

Important as cruisers and trade protection, to which I shall refer presently, are, the Fleet with which we have to attack and overwhelm the enemy's fleet in line of battle, or its modern equivalent, is undoubtedly of the first importance, as I think it will be admitted that the effect of the loss by this country of one great naval action is almost beyond our conception. The adoption of a standard of naval strength based on a numerical comparison of ships between this and other naval Powers, apart from its general inaccuracy, is misleading, and indicative of ignorance of the strategical requirements of modern warfare. It is upon the "work to be done" that the strength of the Fleet must depend, although of course the forces and dispositions of the probable enemies and allies will be a factor in the calculation. Perhaps one of the first ideas to be dismissed, and one which late discussions in this Institute have tended materially to put on a sounder footing, is that fixed defences are to be accounted as of any real assistance to the Navy, beyond that of protecting dockyards and ports from raiders. For if the Fleet is not sufficiently strong to keep the enemy from our shores, no amount of fortifications will do so. Raleigh said: "His master after God will employ his good ships on the sea and not trust to any entrenchment on land." Nelson writes: "We must keep our enemy from our coast if possible and be able to attack him directly he comes out of port." And all history points in the same direction, that the invasion or attack of our ports by anything more than a small flying squadron is impossible while we have the command of the sea, and the power to retain it. It is now over 100 years (1788) since a Committee reported in favour of a large outlay on fortifications, which was supported in the House of Commons by no less a person than Mr. Pitt. The recommendation was based on the supposition that the Fleet might be absent from our shores for four months; and it was defeated in the House on the motion of Sheridan, on the ground that the Fleet never could, would, or should leave our shores unprotected for any such period. Without going into the enormous outlay of money on fixed fortifications since that date, and which I wish I could think was going to be no longer tolerated, the naval "Commander-in-Chief" will at least leave them out of his calculations, on the strength not of naval opinion only, but on such competent authority as General Sir Andrew Clarke, one of the most able Royal Engineers of the day, who has held the post of Inspector-General of Fortifications, and other military men. We must be able to maintain our fleets in such a position and in such predominant numbers that no hostile fleet can count upon the time requisite for any serious enterprise, without

a strong probability of having to deal with a superior force. As the Secretary to the Admiralty said not long ago: "We must possess a Fleet more than sufficient to watch and destroy every war-vessel of a possible enemy," always bearing in mind that the destruction of a Continental fleet would not entail the same consequences upon them as the destruction of our Fleet would upon us. We could not attack them upon land, and they are not, like us, dependent upon the sea for their supplies, the stoppage of which, even for a short time, would cause such misery as very probably to produce a state of anarchy in the country. What this Fleet should be is the question; but it is certain, as Admiral Hornby writes, that "the country which is to keep the sea must have a large superiority over that which can lie in harbour and put to sea whenever it sees a chance." Is the Navy yet up to this standard? There is a strong professional feeling that it is not. The attached "plan" (Table I) which is submitted, *faute de mieux*, as at any rate a plan, though open probably to considerable difference of opinion, points to a lamentable deficiency in cruisers and videttes, two of which it is generally admitted should be attached to every battle-ship. Each squadron should have a torpedo-dépôt ship attached to it. At present there are only two in the whole Navy!

There are twenty-four fast merchant vessels on the Admiralty list which it is assumed could be equipped in eight days, and in preparation for which a subvention of 50,000*l.* a year is paid. In addition to this there are 150 vessels of over fifteen knots' speed available for transports, &c. It is very doubtful, however, how many of these could be withdrawn from their own important work of bringing food-stuffs to our shores and carrying mails. Our policy I consider should be to arm all these vessels at the joint expense of the owner and the taxpayer, and let them defend themselves. I am aware that I might be here reminded of that obstructive document, the Declaration of Paris. But no document must stand in the way of our sea-defence and the steady supply of food and raw material which is essential to the very existence of the people of these islands.

The defence of the commercial dépôts of the Empire has not been considered in this paper, and it must be relegated to local efforts, assisted by the Government as regards the supply of guns, mines, ammunition, a staff of instruction, &c. Our arsenals and coaling-stations must also be secured against possible attack, and the mode of effecting this is not by indiscriminate and costly fortifications, but by mines, movable batteries, and torpedo-craft, and one of the first points which would become evident to our "Commander-in-Chief" is the absolute necessity of the whole of the defence of each district being under the direction of one supreme head.

As I have no intention of criticizing the operations carried out by the various squadrons in the Manœuvres of the last three years, I shall only refer to them in detail in the tabulated form appended (Table-II), which gives the number of vessels employed and general idea, together with a note of the result in each year; but the practical lessons which each taught (and which a *table* cannot record!) are—

TABLE I.—Proposed "Plan of Naval Campaign." Based upon the following assumptions:—

- (a) War with two great maritime Powers, A and B, the strength of whose fleets are respectively—
 A. Battleships and coast defence, 56. Cruisers, 73. Torpedo-vessels (sea-going), 36. 1st class torpedo-boats, 76.
 B. " " " 42. " " " 26. " " " 28.

- (b) This country is without an ally.
 (c) The enemy's war fleets are to be *blockaded* in their ports.
 (d) That main trade routes have been laid down by Order in Council.
 (e) That the Mediterranean trade route will be abandoned.
 (f) That the principal merchant ships are armed and capable of self-defence.
 (g) That the "coaling stations" and "commercial depôts" are *locally* protected:—

(1.) By submarine mines. (2.) Earthworks, armed with quick-firing and 6-inch guns, to cover them. (3.) Torpedo-boats, steam launches, and tug (two of each). (4.) Steam yachts to cruise outside depôts in ports, and at the most important places. (5.) A coast-defence vessel.

- (h) That "cruisers" have a "coal endurance" of 5,000 miles at 10 knots.

- (i) That all "Commanders-in-Chief" are conversant with the "plan," and put so much of it as they consider practicable into practice annually.

Nature of "the work."	Chief "Naval Command" responsible for "the work."				Force "required to do the work."					
	Extent of "command."		Designation.	Headquarters.	Battle-ships.	Satellites.	Cruisers.	Torpedo de- pot ships.	Coal and other ships.	Personnel.
	From	To								
Blockade of ports and protection of channel	Yarmouth— Texel line.	Portland— C. la Hogue line.	The "S.E."	Portsmouth	10	20	15	1	5	10,670
Ditto	Portland— C. la Hogue line.	Selly— C. Finisterre line.	The "S.W."	Plymouth	15	30	15	2	5	14,990
Blockade of war-ships at entrance to Baltic, and protection of North Sea ..	Yarmouth— Texel line.	Shetland— Bergen line.	The "N.E."	Leith	6	12	10	1	5	7,980
Protection of west coasts and ap- proaches	Selly—10° W line	60° N.—10° W line.	The "N.W."	Belfast .....	...	...	10	...	3	3,750
Blockade of Mediterranean and pro- tecting flank of main trade route ..	C. Finisterre— Gibraltar line.	Madeira— Gibraltar line.	The "Mediterranean."	Gibraltar	10	20	10	1	5	10,620
(1.) Reserve squadron	Independent.		The "E. Reserve"	The Downs	6	12	6	1	3	6,050
(2.) Ditto	Ditto.		The "W. Reserve"	Milford	6	12	6	1	3	6,050

FROM NAVAL MANOEUVRES.

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Patrolling prescribed main trade routes. (See Map.)	Lengths.	Rendezvous.	Rendezvous.	"North Atlantic "						
A.B.	1,200	Off Cork	Off Azores	Ditto.....	Cork	4	...	1	1,500	
A.C.	2,400	Ditto.....	Sierra Leone	Ditto.....	Cork and Halifax	6	...	2	1,820	
B.D.	1,900	Off Azores	Off Azores	Ditto.....	Cork and Sierra	4	...	...	1,200	
B.E.	2,400	Ditto.....	West Indies	Ditto.....	St. Lucia	4	...	2	1,820	
D.G.	3,000	Sierra Leone	The Cape	Ditto.....	The Cape	6	...	1	1,070	
D.F.	4,300	Ditto.....	Cape Horn	Ditto.....	Falkland Isles.....	4	...	1	76	
G.H.	2,240	The Cape.....	Mauritius	The "Indian "	Mauritius.....	3	...	1	1,210	
H.I.	2,100	Mauritius	Trincomalee	Ditto.....	Trincomalee	4	...	1	910	
I.K.	1,500	Trincomalee	Singapore	Ditto.....	Singapore	3	...	1	620	
K.T.	2,500	Singapore	Albany	Ditto.....	Ditto.....	3	...	1	600	
G.T.	4,800	The Cape.....	Sierra Leone	Ditto.....	The Cape	2	...	2	1,500	
K.L.	4,800	Sierra Leone	Singapore	Ditto.....	Singapore	2	...	2	1,500	
M.N.	1,180	Tau-kinia (new station Japan Sea)	Hong Kong	The "N. Pacific "	Hong Kong.....	4	...	2	1,500	
N.R.	4,200	Ditto.....	Victoria	Ditto.....	Esquimaux	4	...	1	900	
K.L.	715	Singapore	North Borneo.....	Ditto.....	Singapore	3	...	1	320	
R.V.	3,200	Victoria	Fanning Is. (new station, Pacific).	Ditto.....	Esquimaux	2	...	1	750	
V.P.	1,800	Fanning Is.	Fiji	The "S. Pacific "	Sydney.....	2	...	...	460	
P.S.	1,780	Fiji	Sydney.....	Ditto.....	Ditto.....	2	...	...	1,210	
O.F.	6,400	Australia	Falkland Is.	Ditto.....	Ditto..... and Falk-land Isles	4	...	1	600	
E.P. (if Panama Isthmus is ever open). Blockading entrance to Red Sea (if Canal is not neutralized).	5,300	Taboga (Bay of Panama).	Fiji	Ditto.....	Jamaica	(2)	...	(1)	...	
...	...	...	...	The "Indian "	Aden.....	4	1	1	1,640	

Number required for all Services

Number now available.....

Number building and ordered (new programme)

Additional numbers required. { (1.) To complete necessary "force" numbers required. { (2.) To provide for annual depreciation and wastage

53	108	142	8	49	81,190
45	15	84	2	...	65,000
10	18	42	...	...	None
...	75	16	6	...	16,100
1	7	6	1	...	2,500

TABLE II.—*Summary of Naval Manœuvres.*

GENERAL IDEA.

1887.

Composition of the Squadrons.	<p>(1.) The British Cruisers had lost touch of an enemy's fleet which had put to sea with a view of damaging English ports in the Channel, Thames, Medway, and West Coast of England and East Coast of Ireland.</p> <p>(2.) Special squadron (C) for protection of commerce.</p> <p>(3.) Night attack by torpedo-boats on ships at anchor.</p>					
Squadron	A ¹	A ²	B ¹	B ²	C	Total.
Base of operations.....	—	—	—	—	—	—
Battle-ships	5	5	5	5	—	20
Cruisers. { 1st class.....	—	—	—	—	—	—
2nd class.....	1	—	1	1	6	9
3rd class.....	1	2	1	1	—	5
Coast defence. { Monitors.....	2	—	4	—	—	6
Gunboats.....	16	—	13	—	—	29
Torpedo-boats..	10	—	26	—	—	36
Special service boats.....	—	—	—	—	—	—
Total number of pennants..	35	7	50	7	6	105
Total number of men.....	—	—	—	—	—	—
General result	Deficiency of scouts. Consequent partial success of enemy. Coast defence flotillas, as constituted, offered no real impediment to a properly constituted hostile attack.					

1888.

Composition of the Squadrons.	To blockade two hostile squadrons in two ports before their preparations are completed; the blockading squadrons to prevent the escape of the enemy's squadrons, or, should they fail in doing this, to follow and capture them.				
Squadron	Blockading.		Blockaded.		Total.
Base of operations.....	A ¹ British	A ² ports	B ¹ Lough	B Swilly and Berehaven.	
Battle-ships	6	5	5	4	20
Cruisers. { 1st class.....	1	1	—	—	2
2nd class.....	4	3	3	1	11
3rd class.....	3	3	2	4	12
Coast defence. { Monitors.....	—	—	—	—	—
Gunboats.....	—	—	—	—	—
Torpedo-boats..	8	4	6	6	24
Special service boats.....	—	—	—	1	1
Total number of pennants..	22	16	16	16	70
Total number of men.....	5,134	4,527	3,292	2,998	15,951
General result	That the blockading squadrons were insufficiently and inadequately constituted, scouts being far too few. Insufficiency of connected coast signal stations.				

1889.

Composition of the Squadrons.		(1) Masking the enemy's fleet from a suitable strategic base, watching his movement by means of scouts, and being prepared to follow and destroy him if he puts to sea.						
		(2) Protecting the English coast.						
Squadron	A	B	C	D	E	F	G	Total.
Base of operations...	Milford and Fal-mouth.	Queens-town & Bere-haven.	Lamlash and Fal-mouth.	Ply-mouth.	The Nore.	Hull.	Leith.	
Battle-ships ...	9	9	2	—	—	—	—	20
1st class...	7	2	—	—	—	—	—	9
2nd class ..	6	4	—	1	1	—	2	14
3rd class ..	5	5	—	1	—	2	—	13
Coast defence. { Monitors	—	—	3	1	2	—	—	6
Gunboats	—	—	1	—	3	2	4	10
Torpedo-boats	10	8	4	6	6	2	2	38
Special service boats	—	1	1	—	—	—	—	2
Total number of pennants	37	20	11	9	12	6	8	112
Total number of men....	9,891	7,518	1,317	1,053	975	557	813	22,125
General result.		"Masking" could only be successful with a very large force of cruisers and scouts. The coast defence flotilla, as in 1887, offered no impediment to enemy.						

(1) That the official speeds of ships are unreliable data; (2) That commercial depôts and their approaches cannot be adequately protected by passive defence alone; (3) That speed is a most necessary factor in a war-vessel; and (4) Next to it large coal endurance; (5) That the maintenance of a squadron with coal, stores, &c., requires special and careful organization; (6) The mystery attached to the movements of ships and their object should be abolished, so that everyone concerned should be induced to take an interest in them; and (7) It was most evident that the squadrons were deficient in cruisers and scouts.

I here make a numerical comparison of our naval strength with that of the rest of Europe as estimated for 1894, when our programme will be completed. This comparison may very likely prove erroneous soon after 1894, by some of the other Powers increasing their programme, but it is the nearest at which we can arrive at the present moment. Tables IV and V still further elucidate our position.

Table III.¹

	English.	French.	Russian.	German.	Italian.
Sea-going battle-ships.....	55	34	11	13	13
Coast defence.....	16	22	22	15	4
Cruisers.....	123	73	42	32	24
Torpedo-vessels.....	178	204	117	109	142

¹ This table is compiled from Lord Brassey's Annual for 1888-89, with our new programme and the published new French programme added. "Gunboats" are omitted.—R. C. M.

TABLE IV.—*Summary of Sea-Keeping Fleet (Built and Building).*
I, II, 90.

Relative Speeds.

* Speeds on Measured Mile.	Battle-ships.	Cruisers.	Torpedo-gun-vessels (Satellites).	Merchant Vessels of 1,000 tons and upwards.	—
20 knots and upwards.....	—	13	33		Coast Defence Iron-clads, 13.
18 " "	—	56	—		
16 " "	20	22	—		
14 " "	18	8	—		
12 " "	17	27	—		
Under 12 knots	—	—	—		
Grand totals.....	55	126	33	2,643	

* Note.—These speeds serve as a rough standard for comparison, but must all be reduced by at least 2 knots an hour to give sea-going speed.

Such comparisons, however, can of course only be *numerical*, as it would be quite impossible in this paper to enter into a discussion of the fighting values of the different ships of different nations; my ideal Commander-in-Chief working out his "standards of strength" by the work the Navy has to do, and not by the money which it may fit in with some Chancellor of the Exchequer's views to grant in a certain year (and not for one moment admitting the position taken up a year ago by the Secretary to the Admiralty that the money expended in fortifications is in any way to be regarded as a set-off against a deficiency for the Service), will of course have to go into many details for which I have no time here.

TABLE V.—*Summary of Sea-Keeping Fleet (Built and Building).*

Relative "Endurance."

* Radius of Action (at 10 knots).	Battle- ships.	Cruisers.	Torpedo-gun- vessels (Satellites).	Merchant Vessels of 1,000 tons and upwards.	—
15,000 knots and upwards ..	—	2	—		Coast Defence Ironclads, 13.
10,000 " " " ..	—	13	—		
8,000 " " " ..	—	45	—		
7,000 " " " ..	8	6	—		
6,000 " " " ..	3	10	—		
5,000 " " " ..	15	13	—		
4,000 " " " ..	4	8	—		
3,000 " " " ..	1	13	—		
2,000 " " " ..	4	14	33		
Under 2,000 knots.	20	2	—		
Grand totals.	55	126	33	2,643	

* *Note.*—This table is based on official information, but is probably quite one-third in excess of actual coal endurance. To justify this statement I may say that the "Colossus" is put down as being able to steam 7,000 knots at 10 knots speed, while in reality 3,900 knots is her limit under most favourable circumstances.

This "standard" should be looked upon as the national capital, and being established and annually revised would be the basis of our ship-building policy, the making good of its deficiencies and wastage—when the Fleet has once been brought up to its proper strength—being the elements of the annual expenditure. I may point out that these latter have not been dealt with in the recent Defence Bill, and consequently the business-like proposition of the First Lord in 1887, in which he annunciated the actual value of the Fleet, the rate of its depreciation, and the annual expenditure necessary for replacement, viz., 4 per cent. on armed and protected vessels, 6 per cent. on corvettes and sloops, &c., 9 per cent. on torpedo-boats and launches, and 5 per cent. on harbour craft, is held in abeyance. But it is only by reverting to some such business-like basis that the Navy will ever be steadily kept up to its proper strength. In this reference I may mention a grievous defect in our maintenance of the Fleet. As soon as the number of units of strength required is decided upon, that number should be permanently and constantly maintained in efficient condition. So long as any ship remains upon the effective strength of the Fleet, so long should she be able to take part in any operations; and on a ship being paid off on return from a foreign station or otherwise, she should either be wiped off our effective naval strength, or at once repaired and put in order for commission. In short, no ship should be taken credit for on the strength of the Fleet unless she is ready to go to sea and fight. Under our existing system—

or absence of it—this is not done, and ships remain in the Reserve going from bad to worse for want of this “stitch in time,” and of a sufficient number of people to keep them in proper order while they are in Reserve, with the result that when brought forward again for commission, thousands have to be expended where hundreds should suffice, the vessel having steadily retrograded since she was paid off. This under a proper system would be a matter to be dealt with entirely by the Admiral in command of the district, who should have men and money for the proper care of the portion of the Fleet under his orders, for all which he should be held fully responsible.

My Commander-in-Chief at the earliest opportunity procures the mobilization of all the home forces, in order to apply the best practicable test possible in peace-time to the whole war machinery as he finds it, and he would of course be afloat and watching the performance of the various units at sea with which he had got to work out the problem; the position he would be placed in giving him time for this really important work. If his conclusions were in any way similar to mine—after having had four cruises with the home squadrons—he would wonder how such a collection had ever been got together, and he would in vain seek for any guiding principle in their construction. This would, however, be no great surprise if he had followed the speeches and letters of the principal constructors of modern times; when he found, for instance, that one of the most prominent, Sir Edward Reed, who was for several years Chief Constructor to the Navy, made it his great point to give our ships “greater breadth in proportion to their length,” and so late as 1880 publicly stated that if you wish to build ironclads carrying a heavy armament, coupled with great speed, you must build them circular: when he found the same gentleman, quite recently, advocating the placing of heavy-armour belting completely round the ship, though before Lord Dufferin’s Committee he stated that the plan he recommended “rendered unnecessary all vertical armour except for the citadel:” when he found also that Sir N. Barnaby, who has lately argued that our battle-ships are too large, said so lately as 1888, that “the larger the ship, the greater its offensive power, if it is skilfully designed; and the greater at the same time, and by reason of its bulk, its defensive qualities.”

Even a superficial study of such contradictory views expressed by the leaders of public opinion in this matter will account to him for the motley team he has to drive; and dropping the past, he will consider what should be the features at which to aim in the future. He will see the cruisers, nominally of great speed, unable to maintain more than some 14 or 15 knots, by reason of their shortness and the enormous weights that we have put into them. He will see battle-ships belted to the utmost extent that they are able to carry, and only not completely belted on account of the impossibility of putting any further weights into them without giving them a displacement as yet unheard of. He will see them, by reason of their low freeboard forward and their enormous guns, pitching bows under and straining everything, so as to make their between decks uninhabitable: this from mere straining,

and without inquiry into the effect which would be produced in this respect if they were chasing in earnest, and had to fire their heavy guns many times in the line of the keel, especially from a turret. What would then happen is still left to the imagination! These and many other points will be evident to him, and will be to him a practical "lesson from manœuvres," because, notwithstanding all his nautical experience, he will probably never have had before a chance of witnessing the performance, under so many and varied circumstances, of so many different types of vessels driven at full speed without fear of reprimand as to the coal bill. Freed from the enervating atmosphere of Whitehall, and with the plain evidence of his senses before him, he will say: "These vessels must be longer in order to maintain at sea that speed which in these days is absolutely essential. That being so, however much my friends and advisers, or even I myself, may desire the water-line belt, it must be discarded on account of its enormous weight. Already the greatest differences of opinion exist with regard to its proper length and its proper position. Let us cut this Gordian knot by abandoning it altogether. A protection to the engines and below water should be by a curved steel deck, which is admitted to have three times the defensive power of vertical armour.¹ Let us use vertical armour only for the protection of the guns of both the primary and secondary armaments. The armaments themselves must also be materially simplified. We must have no more ships carrying a dozen different kinds of guns; and, if we are to have torpedo-tubes at all, two or three must be the limit number, instead of seven or eight, as at present. More room must be given to the engines and boilers to enable them to fulfil all their functions properly, the necessity for sudden stopping, turning, and changing speed in the modern man-of-war rendering it essential that every part of her machinery should be much stronger and heavier in proportion than that of a merchantman, instead of lighter and weaker, as at present. More room also should be provided for the stowage of coal." As to forced draught, he will decide on its abolition as far as possible, that is to say entirely for big ships. He will acknowledge that it must be retained for small craft such as torpedo-boats, where, owing to the small size and light scantling of the boilers, all parts are soon and *equally* heated and cooled, while to the boilers of large vessels, where this is impracticable, "forced draught" is simply a "blow-pipe" on the tube-ends and plates, and being connected as they are with rigid masses of stays, plates, &c., something must give way.

He will also see that masts and yards are things of the past, and will wonder why they have been retained in the ships in which new engines or boilers, or both, have been placed. He will know that all

¹ A friend having questioned this proportion, I may say I took it from Lord (then Sir Thomas) Brassey's speech in the House of Commons, when asking for the additional grant for shipbuilding in December, 1884. He said in the presence of, and uncontradicted by, Sir E. J. Reed, that the 2-inch steel deck of the "Meisey" made her equal to the late Russian battle-ships which had 6 inches of vertical armour.
—R. C. M.

yard and sail drill has entirely lost interest among both Officers and men, and is looked upon solely as a bore, taking up time which should be employed in more useful and practical exercises. Much as he may regret that he is never again to come on deck at 7.45 with lower yards and topmasts down, and give the order "one pipe cross royal yards," it will be the same kind of regret that he felt when he first realized that he was never to have the glory of commanding a wooden three-decker with three stern-walks! and he will feel as a practical man that nothing justifies the retention of what is absolutely dangerous in action, and when steaming head to wind impedes the ship's progress by something like a knot an hour! Their disappearance also would greatly increase the space in our now overcrowded vessels, and materially help towards the stowage of more coal.

He will also remember that our annual manœuvres are only a test—and that only partial—of our preparedness at home. Though the whole of the available force of ships in the arsenals of this country has been "mobilized," local communication partly organized, and a small attempt made at protecting our commerce, nothing has been done abroad or with reference to our Colonies. The efficiency of our reserve of ships or men at home has not been tested. The local defences of our commercial ports and their approaches were not tested at all, partly owing to the military being considered out of the game, and their operations, possible and actual, entirely disregarded; and he will undoubtedly come to the conclusion, strengthened by each succeeding year of the manœuvres, that our heterogeneous Fleet is not only susceptible of great improvement in its component parts, but in the aggregate is not sufficient or nearly sufficient, especially in cruisers and scouts, for the work it would be called upon to do. No amount of apparent success gained or claimed on either side in the game must blind our eyes to or induce us to ignore this. He will note that, as before said, we have only two torpedo-depôt-ships, the "Hecla" and the "Vulcan," for the whole Service; and that such vessels, with machinery capable of doing extensive repairs, not only to the engines of torpedo-boats, but to the main and auxiliary engines of ships, are essential to each squadron; and as they cannot be readily extemporized we should be prepared to supply one to every squadron detached from our arsenals. More vessels carrying guns for high-angle fire would be required in war to dislodge ships assembled in large numbers in the enemy's ports. Taking the "Handy" as a fair type for this purpose—more, say half-a-dozen of them, should be built, and they could be utilized in peace for gunnery and mining practice.

As to Torpedo-boats, he will, I hope, relegate them to their proper position as harbour and river defences, and no longer subject both Officers and crews to the useless misery of spending their time on what may be compared to "a half-tide rock" at sea. Having done this, and blocked up their bow ports, which could never be used without almost certain destruction to all on board, and fitted them with pivot-fire only, he will find some use can be made of what has cost so much.

Such will, I consider, be his general views on the matériel provided. But before leaving this all-important subject, sufficient in itself, if one went into detail, for a whole paper, let me point out that there are many other reasons than mere weight for the reduction of our enormous guns before referred to to something much smaller. You do not want a gun to pierce armour heavier than is carried by any nation afloat. Taking the penetrating power as approximately twice the calibre, the 9·2 gun would penetrate everything afloat, with one or two exceptions. No gun should be put on board ship which cannot be man-handled in case of need. Without entering into the question of the exact endurance of the big guns, or our power to construct them, it is evident that smaller ones could be much more easily constructed and given greater endurance, in addition to the immense advantage of much more rapid fire. One or two types also should be selected for the secondary armament, which should not be, as is now the case, composed of several kinds of guns, some of which, at least, have never been submitted to thorough practical trials. Our gunnery depôts should thresh out the details of all guns, and none should be put on board our sea-going vessels until every detail has been practically perfected.

Though more strictly comprised under "administration," I cannot leave this subject without saying that I do not believe we shall ever be right in this most important matter so long as we have to go to the War Office for our guns. The only solution, I believe, is the resuscitation of a separate Ordnance Department, with a civilian head—selected for his knowledge of the subject—and with a naval and military Officer under him to express and look after the requirements of their respective Services. Such department should issue its own orders, and the charge should appear on its own "votes."

In regard to coal-endurance, which is a most important feature, especially in our cruisers, the greater length proposed for the ships, and the abolition of masts and yards, would admit of greater stowage. In view of the absolute impossibility of coaling at sea, the possibility of using liquid or fluid fuel should be carefully considered, as, of course, apart from other advantages, its adoption would solve this problem. We know that Mr. Nobel uses it entirely in his vessels on the Caspian. I am aware that it is usually said that if this were adopted, we should be dependent on foreign supplies. This is believed to be a mistake. Two able, scientific and practical men have written to me lately, strongly advocating its use. One of them says, "if there were really to be a steady demand, I have little doubt that the coking process, now most wastefully carried on, might be made to produce liquid fuel instead of poisoning the air; indeed, I cannot think why this important question of liquid fuel has not received more attention than it has."

I have said that in this paper I lay claim to nothing original. As to the advocacy of higher speed, I may remind you that I am merely going back to the Report of a Committee of 1881, where 19 knots was fixed upon.

Personnel.

Turning next to the personnel:—Although the ships and guns have been entirely reconstructed in recent years, the successful manipulation of the elaborate and complicated engine of war of the present day depends upon the skill of the same men physically as existed in the bow-and-arrow age. But happily, though physically the same, their mental capacity has wonderfully improved while the ships have been undergoing their transformation, owing to advanced civilization, education, and improved treatment in every way. The skill and the bravery of both Officers and men have been, and are continually being, tested in war with the elements, and in overcoming every kind of difficulty when not required for actual warfare; and the behaviour of all during the Naval Manœuvres of the last three years gave every reason for believing that we get the best possible article out of which to construct the trained British seaman. Entering both Officers and men as boys, the whole of their development depends upon our system. Do we employ the best? So far from it, our system of training both Officers and men is much too elaborate and wide of the mark. Too much time is spent at school and college and in training ships. We do not require our people to design or build ships, guns, or torpedoes, but to manipulate them and develop their utmost power, and to have and maintain such physical training as shall, under the misnomer of "nerve," qualify them to handle the biggest ships under the most trying circumstances, never forgetting that a single wrong order at a critical moment may cause the loss of a ship, and perhaps of a fleet. These conditions are to be attained, not by an extensive course of mathematics, physics, or chemistry—all very interesting and valuable subjects—but by actual and constant practice of their real work under all circumstances and conditions. This is what we require for our naval Officers and men. Are we using the best means to attain it? I say "Certainly not." The "Britannia" and the college at Keyham should both be abolished, and Officers entered direct into the Service from public or other schools, and this by open competition, not in special subjects, but in all the varied subjects taught at such places; the first test being only in such subjects, and to such an extent as any properly educated lad of the age adopted, should know; in fact an "Intelligence" examination in which the best are selected. I fear that many of my brother Officers are not yet ready for open competition. But it must come, as it has already in the Royal Engineers and Artillery; and in view of the altered circumstances of the present day, and those to whom nominations are now given, I see no great reason against it. The State should no longer be called upon to bear so much of the charge of the special education of these boys; but, being entered at the age of sixteen or seventeen, when the groundwork of their education will have been laid, they should at once commence at sea the course of instruction and training in what they will have to practise during all their lives in the Navy. The collegiate part of the young Officer's education should be given at the same age as it is to those who go to

our universities, and after a service of two or three years afloat. Every duty on board Her Majesty's ships should be in the hands of Officers so entered and so educated.

If education should not be begun as it now is, still less should it be ended on the present system, by which it is not *necessary* for a young Officer ever to open a book after he is about twenty. Examinations should not cease until the rank of Captain is attained; and without going into details, some such system as that of the Staff College for the Army should be adopted, by which, while no absolute veto would be placed upon those who do not pass, a decided preference, *cæteris paribus*, should be given to those who did pass it, and still more if they passed well. When looking into this question, my Commander-in-Chief would see one paper containing the following opinion of the Germans upon our system: "The Officer entrusted with this duty (of the Central Abtheilung), who is considered about their greatest authority on the subject, told me that the English system of education for naval Officers was considered so utterly unsuited to modern requirements that there was scarcely any part of it which they were enabled to adopt." The opinion of our own Committee, appointed to inquire into this subject in 1885, is expressed as follows: "But we are equally convinced that any system is a faulty one which forces boys to study such advanced subjects at so early an age, and then to a great extent throws away the labour thus expended, by placing the young Officers in such a position that the further earnest pursuit is difficult and antagonistic to the necessary mastery of the duties of an Officer; which demands also that the general education of an English gentleman should be cut short at thirteen, whilst yet failing to secure a thoroughly efficient professional training." In short, they utterly condemn the present system from beginning to end. The present system at Greenwich is as faulty as the site. Whether it be possible to make any other use of that magnificent pile would have to be considered. I am not only aware of, but feel strongly, all the naval sentiment attached to the place; but, apart from the existing defects of discipline and instruction, which are remediable, it is too near London, too full of temptations. The young Officer during his course is entirely cut off from all connection with ships, and knows absolutely nothing of what is going on in the Service, instead of being in close contact with all that is newest and best in ships, guns, and experiments of all kinds, which latter, by the bye, instead of being kept secret among a few select officials, should be witnessed by as many Officers as possible. The "moral" argument, which I believe did much to condemn Portsmouth, may be used with tenfold force against Greenwich.

As regards the Engineers, as a separate class they should disappear. We do not require high scientific knowledge of an elaborate order to work and look after a ship's engines. It is a matter of experience and common sense. We have never had a more valuable and more highly respected Officer in the Service than the old Chief Engineer, who never arrogated to himself any special scientific

attainments, but knew his work and did it well. He was essentially practical, and that is what we require. We require specialists more than ever to look after engines, guns, and torpedoes. But there is no reason whatever to suppose that if an executive Officer devotes as much time to learn engineer's work as he does to learning torpedo work, he would not be perfectly competent to supervise the engine-room artificers, by whom the principal part of the engineer work is now performed; and the "Engine-room Lieutenant" would bring to the discharge of his supervising duties, the habits, constitutional and acquired, of supervision and command which are known to be the characteristic of the class which he joined on first entering the Service; and his occupation would certainly be as useful as the "Torpedo Lieutenant's," the "Navigating Lieutenant's," or that of any other special branch. The engine-room staff would thus comprise a "military branch" Officer, in charge, with one, or perhaps two, assistants of the same branch, and we should in this way be able to enter more Officers available for many purely naval duties. Below these there would be the "engine-room artificers," and a rating of petty officers—"seamen stokers"—in several grades. These petty officers would be as permanently assigned to engine-room duties as the gunnery instructors, torpedo instructors, captains of turrets, &c., now are to their special duties. The remainder of the engine-room complement would become a "part of the ship," through which the whole seamen part of the crew might be put in the course of commission. Every stoker would thus be trained to arms. I have said that the Manœuvres showed, *inter alia*, our deficiency in stokers. It may not be generally known, but I mention it in proof of my assertion, that we actually had to fill up our Fleet with stokers who were, and are now, in receipt of Greenwich Hospital aid for serious physical defects! No wonder complaint was made of the physical inefficiency of the mobilized stoker!¹ The present distinction between "combatant" and "non-combatant" should disappear. Every person in the ship should be a combatant, able to take an effective part in offensive and defensive work. Why should the Engineer be a non-combatant? Why should the Paymaster or the Schoolmaster? both of whom, however, should disappear in these days. The Admiralty should insist upon everyone knowing the principles of offence and defence. Naval instructors would of course disappear, and the young Officers would be instructed in practical navigation and languages by an additional Lieutenant; and, indeed, the far greater part of the education of Officers, as well as of men, should be carried out by those actually serving as combatant Officers on board Her Majesty's ships at sea.

I am not for one moment supposing that such changes can be made by a stroke of the pen, or by anything but gradual entry at one end

¹ It having been stated by the Chairman in the discussion that no complaints were made by the Captains of the ships employed in the manœuvres as to paucity or inefficiency of the stokers, but that, on the contrary, a large number remained in port, I wish, in addition to the statement as to how the numbers were made up, to call attention to Table A, p. 440 of Brassey's Annual, 1888-89.—R. C. M.

and extinction at the other; and in bringing such views prominently forward I would rather be considered in the position of one pointing out what he believes to be the inevitable and proper thing to all concerned, whether as those who make the changes or as those who are affected by them, viz., to prepare for them, and to smooth the way.

The Paymaster, a non-combatant Officer, should be allowed to die out, and his place and duties should be taken by a Lieutenant, assisted by petty officers—executive—as “writers,” which latter should become extinct. I have the evidence of several of the oldest Paymasters and secretaries, that there is nothing in their duties which could not be thoroughly well performed in this way; and indeed experience, where this has had to be done, has shown it to work admirably. An Admiral's secretary of considerable experience assured me that two of the best writers he had ever had were two injured seamen, sent to him as an experiment by the Commander-in-Chief of the station.

The volunteer “seaman-gunner,” so-called, should be abolished. Every person should have a certain knowledge of gunnery, torpedoes, and signals, but to specialists only should the higher knowledge be imparted. Captains of guns and torpedo-tubes, instructors in gunnery, torpedoes, and signals should be selected from the best men, and be well paid. The rest should be trained to work the guns of the ships to which they are attached. But everyone in every ship should have a knowledge of the rifle, pistol, cutlass, and small quick-firing guns, as well as of ordinary “signals.” One of the greatest evils of the present system with the seamen, creating perhaps one of the greatest difficulties of the day, springs from the unhappy mania for over-training Officers and men under a system which necessitates long continuance in harbour, or even on shore. It was well said to me by a very able Officer but a short time ago, that no one ever proposes anything that will add to the time spent *at sea*. It is believed that the seaman-gunner of to-day does not spend more than seven out of his twenty years in an actual sea-going ship. Yet, while all this “fancy work” is going on in our naval ports, the Steam Reserve has not men enough to keep the ships in its charge even in moderately good order; I believe I do not exaggerate when I say not even enough to keep their double bottoms clean, this being a matter requiring no small amount of labour. This paucity of men for ordinary work is one of the causes, referred to before, of the waste of money upon ships when brought forward from the Steam Reserve for commission.

It is well known that most of the ships when they are paid off are in better order than they have ever been before, and that if the necessary repairs were taken in hand at once, and the ship kept up to the mark at which she should be while in the Steam Reserve, thousands of pounds would, as has been before said, be saved on every ship when re-commissioned. This will bring my Commander-in-Chief to a consideration of the number of men now voted for actual service with the Fleet and the Reserve, upon which he can lay his hand in the event of war. I pass by the additions necessary to

meet the increased Fleet of 1894, the entry and training of which I presume we shall all agree should be commenced at once. Seventy new ships are to be produced by 1894, and 1,000 to 1,500 men should be added to the Fleet in the forthcoming Estimates. But apart from this, the whole system of employment of our men is faulty; and the Reserve, at any rate, is deceptive as to our available strength, and we should find to our cost, in the event of war, a very small portion of the Second Class Reserve available. It is a literal fact that when the last war-scare took place, the men in training on the North-east Coast disappeared, and on the Officer in command of the district asking the Inspector the meaning of this sudden diminution of the number of men at drill, he was plainly told that they had gone on account of this scare and the possibility of their being called upon to fight, which they had never had the slightest intention of doing! The fact is that by far the greater number join for the 2*l*. 10*s*.¹ bounty, the suit of clothes, and the six weeks' keep. They would vanish into thin air when wanted for service. This system should be swept away, and the First Reserve increased. Space does not here permit of going into further details than to say that this force should be so reorganized as to make it, at least for the greater part, constantly interchangeable with the sea service, and the fishery and several other duties now performed by the "regulars" should form part of the reserve work. The increase should be to the extent of giving enough men for keeping all the vessels in the Reserve that I have spoken of, in proper order. These vessels should have (say) half their proper ships' companies always on board, and being under the command of a combatant Officer—probably the "Engine-room Lieutenant"—the men could be regularly assembled for drill, both on board and on shore, as often as is considered desirable. This system of seamen and sea Officers living on the sea is, I submit, far better as well as far more economical than the naval barracks so strongly advocated by some Officers. Not only would the ships all be kept in order, but when mobilized or commissioned they would have half the crew conversant with all the intricacies of ship, guns, and engines, instead of an entirely raw set. One, at least, of our most highly esteemed Officers is strongly in favour of the Russian system of permanent crews. They have a full complement of both Officers and men for every man-of-war from the day she is launched till the day she is finally condemned as being unfit for service. The men live in barracks, and the Officers on shore in lodgings, &c. I understand, however, that they have lately seen occasion to introduce a change. There are many difficulties in such a scheme, and with us the number of men necessary to be maintained at all times for full crews would probably be a practical bar. But apart from this, it must seriously detract from that flexibility which is of such importance in naval mobilization; some men might belong to the same ship all their time, and she might be a "Glatton," or some coast defender,

¹ Originally stated in error to be 6*l*., that being the amount paid to First Class Reserve men.

while others might be all their time in the training squadron, or some vessel employed for five or six years on a foreign station. With great deference, I confess I do not see how this system would work advantageously with us, though something would be gained if we get the proper number of men into the Reserve by their interchangeability every two or three years with men serving in sea-going ships. As you are probably aware, the present Royal Naval Reserve, as established by the Royal Commission presided over by Lord Cardwell in 1858, has never been brought up to anything like its authorized strength, viz. :—

Authorized strength ¹ ...	920 Officers,	30,000 men
Actually enrolled	264 ,,	18,000 ,,

As it is well to know what qualified lookers-on think of our system, I quote the following views from the very able report of Lieutenant Colwell, U.S.N. : "The material of which it is composed is admirable, but the system is open to the objections that these men, if drafted on board a modern man-of-war, would be nearly as useless as any other untrained men their training would be found to be of little value, for they have no permanent organization, no permanent Officers whom they know and to whom they are accustomed, no uniform system of instruction has been given them, and the weapons, with which they have been in the habit of going through their annual drill are obsolete, and no longer find a place on war-ships. The short periods of training with strange comrades, strange Officers, varied weapons, and unfamiliar surroundings, owing to their constantly changing the place at which they take their drill, cannot possibly give them the discipline and systematic way of performing their duties so necessary to the fighting efficiency of that complicated machine—the war-ship of the present day." And he goes on to give it as his opinion that it would be a "liberal estimate" that one-third could present themselves at the rendezvous in a fortnight—*very* liberal, I think—and "those might find themselves drafted to a class of vessel with which they were totally unfamiliar, and stationed at a type of gun they had never seen."

The Royal Naval Artillery Volunteers might be made into a very useful corps if turned into the artillery more in keeping with their name instead of the hybrid they are at present, and increased to, say, 5,000 strong. They would then form part of the force under the naval Officers who should command all our coast defences. They would be most useful, also, to release the large number of coastguardsmen whom it would now be necessary to retain for our coast signal stations.

The training, pay, and position of signalmen is still much below what it ought to be, though it has been improved of late. The importance of this body in war-time cannot be overrated.

¹ It was stated in the discussion that the numbers actually enrolled—especially of Officers—are considerably in excess of those put down. I am very glad to know it, but cannot at this moment lay my hand upon any data from which to correct the above.—R. C. M.

Though perhaps it may be considered almost a detail, Admiralty messmen are a requisite of the new order of things. They are an absolute necessity of the manœuvres for the hurriedly mobilized Fleet, and ought to be supplied to all Her Majesty's ships.

All the various duties of *actual service* along the coast,—the principal among which in time of war, and now that smuggling is almost entirely a thing of the past, viz., the working of various coast signal-stations all over the kingdom, would be performed by the Reserve men. I feel sure that it would be now found that in addition to the failure of the Second Class Reserve to produce anything like its supposed quota, at least a third of the present Coastguardsmen would be unavailable afloat in war-time, having to be left on shore for signal purposes; as I can hardly suppose it is the intention to leave the signal-stations round our coasts entirely unprovided with efficient signal-men just when they are most wanted. At least, such would not be the view of my ideal Commander-in-Chief! The whole importance of these signal-stations was demonstrated in all the Naval Manœuvres, but perhaps more particularly in those of 1889, which showed that although an enemy might run up the Channel, and threaten various ports, he could not remain long without being brought to action, provided we kept up an efficient home fleet and well-organized and connected signal-stations. The difference in this respect between 1887 and 1889 was very marked. The connection of these stations is also a matter of immense importance. To conclude my remarks on this head—the whole forces and the whole defences of each section of the coast should be actually under the single and sole command and responsibility of the Admiral in command of the district, holding a position somewhat analogous to that of the *Préfet Maritime* in France, the separate Admiral in command of the Reserves being suppressed; and thus alone can our Fleet and coast defence be properly conducted. Such a position and such a responsibility also can alone in these days justify the existence of a Commander-in-Chief at a home port, who will inevitably be economized off the face of the earth, unless he can show some better reason than I fear he could of late years, to justify his existence. In short, he must be something more than what a Commander-in-Chief at Portsmouth once told me he considered himself, “a big Midshipman!”

Promotion, Retirement, and Pensions.

Though it will be upon financial grounds that this question will be forced upon us, and it concerns principally the First Lord and Financial Secretary, it is one which cannot be ignored, and the sooner it is realized that the days of a “Non-effective Vote” of over three millions sterling annually for the Navy and Army are numbered, the better, so as to avoid hasty and ill-considered action. The present system of promotions, retirements, and pensions is most unsatisfactory, and entails immense expense upon the taxpayer. It is—especially since the Childers scheme—demoralizing to the young

Officer, as it debars him from looking upon the Navy as the work of his life; and it tends to blunt the energies, chill the ardour, and repress the zeal of both Officers and men. It is deplorable that many Officers are now retired nearly in the prime of life, costing the country an enormous sum for which no value is received, when they might and should be most usefully employed in the Reserve. This should cease; and as it is essential that provision of some kind should be made for the country's worn-out servants,—to prevent the otherwise possible spectacle of an improvident Officer sweeping a crossing in an Admiral's uniform!—every public servant should provide for his own pension by a compulsory deduction from his pay. Comutation of the *whole* amount should never be allowed; it has brought a fearful amount of misery on many Officers. All pensions for good service, wounds, &c., should cease, and grants be given instead.

Maintenance of Squadrons and Depôts.

Turning to the immensely important point of the maintenance of squadrons and depôts at home and abroad with fuel, ammunition, and stores, as also arrangements for their refit during war, ample employment for organizing powers will still be found. Although there are abundant means all over the Empire for transporting coal and stores, little has been done towards perfecting the arrangements for supplying squadrons, or ships of war actively employed, with rapidity and certainty. The importance of this is second to no part of the naval programme, as without such facilities the very best ships and the best men are powerless. Some slight notion of what we require, in one branch alone, may be gathered from the fact that during the late manœuvres a fleet of twenty-seven vessels was employed to convey coal to the squadrons engaged, several vessels making more than one trip. Coaling at sea being, as I have before said, out of the question, and only to be solved, if solved at all, by the use of fluid fuel, blockading and other squadrons must seize and occupy any convenient places in their neighbourhood for coaling; and the question of furnishing colliers with more rapid means of discharging coal, and our ships with more rapid and convenient means of receiving it and stowing it away, and whether it would be more economical to supply coal from a store kept at the pit's mouth and ship it only as required, instead of being shipped and re-shipped several times as it now is, form matter for serious consideration. Our deficiency in coaling-station armament has been so seriously taken up of late that one does not like to criticize the long delay. I will only submit that, as far as possible, here as well as at home, colliers should be the stores instead of landing coal and having to re-embark it to its manifest and great detriment. Special ammunition-vessels fitted to stow each kind of ammunition so that it can readily be got at, will be another necessity. Docks also, capable of taking in our heavy ships, are of the utmost importance, especially in such places as Bombay and Gibraltar, which latter is of far more importance to the British Navy than any

other position out of England, Malta included. A dock at Gibraltar, which private enterprise is fully prepared to construct, is of the utmost importance, as well as a considerable increase in the length of the new mole; and I trust that this session will not pass by without something definite being done with reference to this question.

Time precludes my more than glancing at the fact before mentioned that the Naval Manœuvres are at the best but very partial, and that they throw no light on the more extensive questions of colonial and commercial defence. The new colonial ships are a good omen of the worthy part which our colonial offspring is prepared to take for the general weal of the entire kingdom, and I expect to see the colonial forces, both on land and at sea, gradually increased year by year until they become as formidable as their countries are important. I consider that we should enter, both as Officers and seamen, a proportion of lads from the colonies annually, to be paid for by them, who will when trained, become the Commanders, Officers, and the instructors, if not the whole ships' companies, of the colonial war-ships. These ships should be annually mobilized with our Australian squadron, and, if possible, the Training Squadron, and any other ships that can be collected from a reasonable distance, should manœuvre together, and make the same tests as are being made by the manœuvres at home.

The number of cruisers required for commerce-protection is subject to the greatest difference of opinion; but some attempt has been made to formulate views as to the number required, in the table before referred to (Table I). Our commercial routes in war-time should be authoritatively laid down by Orders in Council, in some such way as in Table I, and any ship captured off them, should forfeit all claim to compensation. I see no reason why such prescribed routes should not be patrolled by light fast cruisers in open seas, and by heavier vessels at their convergence towards the dépôts, at the entrance to the English Channel, and other points which lend themselves most to an enemy's attack in force, especially if, as before laid down, every merchant ship with a speed of over 15 knots, were armed for its own defence.

Time again prevents my dealing with the question of attacking open coast towns, about which a good deal has been said of late. But I feel sure that anyone who has read the articles written by foreign Officers, as well as by civilians and international lawyers, on this subject, will be convinced that we should be trusting to a very rotten stick indeed, if we considered that our open towns will be free from threats used for the purpose of extracting a ransom such as is admitted to be perfectly justified in the case of a General with an army before an unfortified city. There is no reason for supposing that a different measure would be meted out by a Continental navy from that which is invariably meted out by their armies. I may, however, quote a few words from one of the last articles by Captain Stenzel of the German Navy on our Naval Manœuvres of 1889, in which he says there are other means of arriving at a victory over us than annihilating our Fleet: "Great Britain is open to attacks on all

sides. The population is dependent for its food and raw material on the constant and uninterrupted supply from foreign ports *add to these the panic caused by the bombardment of a few coast towns.*" And he adds that the strategy will be "to appear everywhere, like the 'Anson' before Aberdeen, and at no point where an attack might be expected!"

Administration.

Lastly, but by no means least, my Commander-in-Chief, having returned to Whitehall, turns his regard inwards upon the establishment with which he is working, and which is working sometimes with, and, alas! not unfrequently against, him; and asks himself if this system is best adapted to call forth, train, and make the most of the resources in money, men, and material placed at its disposal.

But the path of the reformer is beset with many difficulties. An instance of this is the feeling about the Board on the part of those who, having been used from childhood to that time-honoured institution, hug themselves with the idea that no efficient change is possible, because, say they, "at any rate our system works better than the War Office;" and some consider that a more distinct definition of responsibilities would weaken the position of the "Naval Lord" in the eyes of the Service, an idea begotten and fostered by a false impression of the regard in which an individual "Naval Lord" is held by the Service. Of course a certain amount of deference is paid to him because he is generally an Officer of high rank, and it is also known that he has the ear of others who with him make a power. But the fact that it requires two men and a secretary to do anything is perfectly patent to everyone in the Service, and is a ridiculous position which has been freely commented on in the evidence given by Naval Lords themselves before the various Commissions and Committees which have been held since the Crimean War. This evidence, which shows throughout the diametrically opposite views taken by various civilian First Lords and Naval Lords concerning their own and each other's positions and responsibilities, would be quite enough to condemn the existence of the system, even without quoting such emphatic words as those of that distinguished Officer, Admiral Sir Thomas Cochrane, who, before the Committee in 1861, when asked—"I gather from your evidence that you believe that nothing can be worse than the present system of the Board of Admiralty?" answered, "I think so. It is as bad as it possibly can be." This answer, I would remind you, was given in the days of the old system, years previous to Mr. Childers' Orders in Council, which some would try to persuade us are the root of all the evil. The actual fact, which is beyond denial, is that the existing system has never worked well during the whole period of its existence. It is an institution honoured by time, and by nothing else, which tends to hamper an energetic administrator, and to shield from due responsibility a weak or inefficient one; and whatever good has been done—and in this respect, as before said, I would give great credit to the administration of the past few years—

has been done in spite of the system, and not by its aid. The Board, according to its own internal evidence shown in various Blue Books, never was a reality, and during the last twenty years it has been a positive fiction. There is not either, and cannot be, any continuity of policy among a set of men, no matter how able they may be, who are here to-day and gone to-morrow.

The Board is a misleading fiction also to the House of Commons and the country, because, although the First Lord may say he is absolutely responsible for everything done at the Admiralty or laid before the House in connection with it, the House and the country generally are under the impression that his utterances are made after consultation and agreement with his naval advisers. The late discussions, and the evidence before the Navy Estimates Committee, have only begun to give them a glimmering perception that the First Lord *may* be speaking of what "we" have decided upon, when it is really his own decision, and against the opinion of some, or even possibly of the whole of the naval element. There is no way at present for the public to ascertain what is the opinion of the Naval Lords upon any subject. The problem is, how to administer the affairs of a great Navy, under a system of strong Parliamentary Government. I am aware, and as a naval Officer I sympathize with it, that there is a strong feeling among my brother Officers, of impatience at what they consider the interference of Parliament. However unpopular it may be with such to say it, it cannot be too strongly pointed out that the sooner this feeling is eradicated, the better. Parliamentary interference with everything, is part of the price we pay for our liberties, and as Parliament becomes more democratic in its tendencies, it will become all-pervading. But I would remind you that its sole object is resistance of officialdom and the evil liking for secrecy among those in office, and, as I have suggested, everything would appear open and above-board, if official answers to questions were given straightforwardly, instead of being, as they too often are, purposely to conceal what has happened, and Parliament would be found working in support of the nation's executive instead of against it. It was with pained surprise that I heard a "Sea Lord" speak before a House of Commons' Committee of its being "no use to speak" of having ships for which the House of Commons would not vote the money. The Service should be reminded that the House of Commons has never refused, and, I believe, never would refuse, to grant money for the Navy when it is asked for in a straightforward manner by a responsible Government. What the House does want to know, and what it will insist upon knowing, is how the money voted is spent. The very *raison d'être* of naval administration is to prepare and organize an adequate defence for the Empire, and to protect its commerce crowded on every sea, from the destruction which would possibly, if not probably, involve our national extinction. It may be taken as admitted that until quite lately, our naval administration had endangered our maritime supremacy; and yet it would be unjust to fix the responsibility on any particular Board, still more under our present system upon any individual member of any Board.

I presume no one will dispute that the head of our administration must be a Cabinet Minister, as otherwise the Navy would be without any voice at all in the great council of the country. Its voice is not strong enough as it is, and Heaven forbid that we should weaken it! If this be admitted, it follows that as a rule the First Lord must be a civilian, for it is very seldom that a naval Officer, from the nature of things, can attain to Cabinet rank. It may be questioned whether he would be the best man for First Lord under any circumstances. My reforming Commander-in-Chief, being free from any prejudice, would at once see this necessity, and that whether he be called First Lord, Naval Minister, or by any other title, he must be supreme. But this affords no reason why he should not have the most able naval Officer that can be selected at his right hand constantly to advise and consult with him, who would, under ordinary circumstances, be the exponent of the views of the naval element, and whose opinion, when it differed from that of the First Lord, should in some way be made known to the House of Commons and the public. In short, I see no reasons for, and many against, any secrecy whatsoever as to what goes on at the Admiralty, whether it be as to experiments or simple business, beyond the exact orders sent to the various Commanders-in-Chief, as to the steps they would take in the event of the outbreak of war, or strained relations with any given country, so far as this can be laid down beforehand. In this respect I would remind you that it is from us alone that any such matters are kept. For, as was well said a few years ago by the present respected Leader of the House of Commons, who has served his country both as War Minister and First Lord of the Admiralty: "It is imbecility to suggest that foreign Powers do not know the condition of our forces of every kind at least as well as every Minister of our own Government, with the exception perhaps of the Secretary of State for War and the First Lord of the Admiralty."

I do not propose to give a scheme of administration, though I have one prepared, because the details of arrangement must be fully gone into by a Committee; but I chiefly insist, as before said, on the First Sea Lord—by whatever title called—being relieved of that amount of petty detail which now occupies the greater part of his time, and prevents the possibility of his giving that attention which should be given to the formation and administration of the Fleet in all its branches. As the First Lord's acknowledged prompter, as the adviser of the other Lords, as well as of all Commanders-in-Chief and others who sought his opinion, and as head of the Intelligence Department, he would find ample occupation for his time, energies, and abilities, and he could have the opinion of the other Sea Lords whenever he chose to ask for it, as they could have his. But without here deciding the precise number of such Sea Lords, it should be stipulated that, except when specially called upon by the First Lord or First Sea Lord for opinions on general questions, they should attend to their own special departments as laid down. Each of these Lords would be the better for a naval assistant, and I cannot see why the *naval* work of the Admiralty should not be performed by those

who understand what they are writing and talking about. I emphatically disclaim any attack upon the civilian clerks at the Admiralty; for there are unquestionably many duties which they are admirably qualified to perform and do perform with undoubted zeal and ability, but I claim that the distinctly naval and military branches should be handed over to Naval Officers.

All the Lords and other Naval Officers should be appointed for a fixed period of three, four, or five years; and care should be taken as far as possible that they do not leave at the same time. How can continuity be expected when we remember that for instance in the thirty-two years after the last Lord High Admiral (1827 to 1859) there were seventeen First Lords, or on an average one year and ten months to each; and 103 members of the Board and Secretaries, giving an average tenure of office of four months each. Almost any period would show the same. Take from 1880 to 1888. We have had three First Lords, sixteen other Lords, and seven Financial Secretaries, giving an average of two years and eight months for the First Lords, six months for the Sea Lords, and one year for the Secretaries, so that the British Navy is governed by a First Lord, who, though he calls himself absolute, cannot sign or speak in the first person, no matter how much he may differ from the others; who has no power to issue a single order without the signature of a Lord and a Secretary, and yet who practically overrules them all; who has an average experience of little over two years and a half, while he probably entered office in utter ignorance of everything connected with the Service, and—and here is the worst feature of all, and one for which no political excuse exists—he is advised by naval Officers who have held office for an average of six months! and by a Financial Secretary who usually commences with the same utter ignorance of the subject as himself, and whose average experience is one year.

To sum up, the defects of the Board are :—(1.) Want of spontaneity; (2.) Want of unity; (3.) Indirectness of purpose; (4.) Tardiness in action; (5.) Wastefulness in expenditure; and (6.) Lack of individual responsibility. To which I may add a general disposition to meddle in the affairs of every Commander-in-Chief whether at home or abroad, and to consider that all naval knowledge and all administrative ability is concentrated in themselves. What is required for an efficient administration is *personal* responsibility and supervision. Decentralization, as far as our Parliamentary system of Government will admit, is much needed; and increased power and responsibility should be given, as I have before said, to Commanders-in-Chief, especially at home ports. Ships, guns, and men are of no use, and the money voted by Parliament is only squandered, unless there exists a proper administration for designs, training, equipment, and maintenance. The Naval Estimates have been much improved in their form, but, to repeat the Secretary's own expression, "though much has been done, much more remains to do." Dockyard administration, though greatly improved of late, is by no means yet what it should be. It is a self-evident proposition that if the Royal Dockyards are worked on a proper basis, ships should be built there more cheaply

than they can be in contractors' yards, by the amount which the contractor must make in order to live. But so long as the ships building in our yards are saddled with incidental charges for schools, chapels, libraries, clothing, &c., so long as men are liable to be knocked off building for the purpose of repairs, &c., so long will no fair comparison be possible between Royal and contract yards. All dockyards should in the first instance be considered as a "National" charge, because they are maintained for many purposes beside shipbuilding, and most of them would have to be kept on equally if every ship were built by contractors.

Again, the whole system of estimates for repairs, &c., is most wasteful. The dockyards, as well as everything else within his district, should be under the direct control and responsibility of the Commander-in-Chief of the port. The Superintendents of all the dockyards should be appointed for not less than five years, irrespective of their rank. Under the present system they frequently remain only $1\frac{1}{2}$ to 2 years—there have been four at Pembroke since 1885—and they leave just as they are beginning to know the work and place. Efficient superintendence under such circumstances is impossible. The Port Admiral should be provided with funds from time to time for the repairs and other work which have to be carried out. He should have entire responsibility for each "unit of strength" being put in order as rapidly as possible on being paid off at his port, for being kept in proper order when she is in the Steam Reserve, and until she passes out of his hands on his final inspection of her when she has been recommissioned, and is about to leave his port.

To this I would again urge that the present system of placing the passive defences of the Empire in the hands of a military Officer—independent of his colleague—and the active movable forces in the hands of a naval Officer, will inevitably lead to confusion and disaster. One man should be held responsible for the defences of his district; for the state and efficiency of mines and floating batteries, the working of signal stations, and the communications not only between them and ships at sea, but also between them and headquarters, as well as for the efficient mobilization of the reserves of his district. In short, everything should be in one hand and under one head, who would of course be supplied with sufficient subordinates to carry out all details of work. Lieutenant Colwell, U.S.N., may well be again quoted as a perfectly independent and able exponent of the necessity on which I have insisted of placing *all* our coast defences under the one naval head. He points out that the Germans have now transferred all theirs, including the fortifications at Kiel, Wilhelmshaven, and the mouths of the Elbe and Weser, from the Army to the Navy, and much the same system obtains in France; and, after giving several detailed reasons in favour of it, says: "Complete unity of control is thus established. . . . The coast defence of Great Britain is notably the most inefficient of any of the great European Powers. Owing to divided control, lack of co-operation, absence of digested schemes for mutual support, and the mixing of naval and military duties, the defence is unwieldy in its administration, unprepared for

sudden work, and labours under the disadvantage of placing military men in situations outside their legitimate sphere of action." That this dual system is a gross waste of money is undeniable.

Although I have avoided, as far as possible, going into minute details, I feel that I have already carried this paper beyond the ordinary and defensible limits. My excuse must be the vastness and importance of the subject. I felt this at first, and felt it still more as I proceeded; for what are not the lessons which may fairly be said to be learned by, through, or in connection with "Naval Manœuvres"?

If some of the ideas broached are considered infeasible or bad, I only want a fair consideration of them before they are utterly rejected; and if the smallest benefit accrues to the Service from this paper or its discussion, I shall no longer regret my temerity in venturing to give a lecture on such a subject in this hall, nor object to any criticisms which may be made upon it.

Captain BRIDGE: Before the discussion of the views which have been so ably and clearly put before us by Admiral Mayne begins—as I think it would be improper for an Officer holding an official position, as I do, to enter into any discussion of those views, or to express any opinion either in favour or opposed to them—I venture to ask permission to briefly call your attention to one statement of fact, a statement the truth of which I do not for a moment call in question. But I would ask those of my brother Officers who are here present to allow me to call to their recollection another statement of fact—another series of facts—which I think they should place side by side with the statement which we have just heard from Admiral Mayne. His statement is this: "It is a literal fact that when the last war scare took place, the men in training on the north-east coast disappeared, and on the Officer in command of the district asking the Inspector the meaning of this sudden diminution of the number of men at drill, he was plainly told that they had gone on account of this scare and the possibility of their being called upon to fight, which they had never had the slightest intention of doing." Now there are a great many Officers, perhaps a good many of us here present, who remember what was called the "Trent" affair, and I appeal to the recollection of every Officer who can carry back his knowledge to what then took place to say what the position of the Naval Reserve men of that day was. Is it not a fact that they came forward in all parts of the country, without even being called upon, to offer, if need be, to fight for their country? I think it would be a very unfortunate thing if the statement which has been made in the lecture—the truth of which, as I have already said, I do not doubt for one moment—were to go forth from this Institution without the corresponding statement accompanying it.

Captain CLEVELAND: Although I may say I am in accord with much that the lecturer has said, embracing, as it does, a very vast range of subjects, including almost the whole of the administration of the Navy, pointing out to us of what vital importance mobilization and subsequent manœuvres are to our Fleet, yet I will just make a few comments for the purpose of stimulating discussion and eliciting the opinions of my brother Officers. I do not agree with the lecturer upon the question of abolishing sails in cruisers, though I may say I do as regards battle-ships, especially those with double screws. I am well aware of the reasons for abolishing sails—the liability of the rigging to foul the screw, the amount of space required for spare sails and rope, and also, I may add, their additional weight, both of which might be allotted to increased coal stowage; still, when we consider that our cruisers have to *keep the sea*, not merely to make a passage, they have to husband their coal, and should for that purpose be able to travel under sail; I think ignoring the great natural motive force of the wind is a very great mistake. Our ships should have very powerful fore and aft sails—I am speaking entirely of cruisers—as well as square sails. I see no difficulty, in these days of mechanical contrivances, in both rapidly and snugly disposing of the upper masts and yards. I think we

could let them down with the greatest possible ease, and there would be no fear of their fouling the screw. I should like to elicit the opinion of my brother Officers most particularly upon this point, whether sails should be entirely abolished in our seagoing cruisers. With respect to the lecturer's remarks about our guns, I certainly am very strongly in accord with him. He speaks first of all of heavy guns, and says that no gun should be put on board a ship which cannot be man-handled in case of need. I think that is a most important point, otherwise with the delicate machinery for working them, which is very liable to give way, you would lose a very large fractional part of the power of your ship in a very short time.

Admiral Sir GEORGE WILLES: Can you man-handle a gun of 50 tons?

Captain CLEVELAND: My opinion is you can man-handle the mechanism of a 12-inch 45-ton gun. I throw that out as a suggestion. I am sorry to see we have adopted the large heavy 67-ton guns (which cannot be worked by hand) in our new battle-ships. To my mind it is a very serious matter. I think myself, seeing that a 38-ton muzzle-loading gun has been worked by hand, there is no reason why a 12-inch 45-ton gun should not be worked by manual labour as well as by machinery. Then comes the question of the number of guns on board ship. Having a large number of guns means a large number of magazines, and variety of stores, and possible confusion in the supply of ammunition. In some ships we have as many as ten or twelve kinds of guns on board, and the number that there are in the Service I could not enumerate. I should like to see a strong stand made to simplify the working of our guns, their ammunition and stores, and 95 per cent. of them pitched into the "scrap heap," for the enormous variety of guns must lead to great confusion in war. The lecturer points out most distinctly that one of two types should be selected for the secondary armament, perhaps the 47-inch and 6-inch quick-firers when they are thoroughly thrashed out; but let us have no gun that is not thoroughly thrashed out in all its details placed on board any of our seagoing ships. Turning our seagoing ships into experimental vessels is undoubtedly a mistake. I quite agree with the lecturer's doubt as to the expediency of our merchant ships taking the place of cruisers in the event of war. In my opinion it would be a very grave mistake if we attempted to withdraw ships from industrial pursuits in war-time. How is the food supply and the raw material that is required in this country to be brought to it except by means of these powerful and fast ships? I entirely agree that what we should do is to arm these vessels (every arrangement being perfected in peace-time) and let them look pretty well after themselves. I attach immense importance to the "Plan of Campaign," which I congratulate Admiral Mayne on having produced. It is the only business-like method of ascertaining the number and the nature of ships we should require in war-time for the "work" we have to do. Having got that clearly in our heads, the next thing is to see what is the "force" required to do it, both in matériel and in men, and upon this basis our ship-building policy, as well as the entry of men, should rest. As regards torpedoes, I go further than the lecturer. I am one of those who are entirely against having torpedo tubes *above water* in battle-ships. I think they should be relegated to special vessels, but I should like to hear the opinion of the meeting upon that point. I see the lecturer speaks of special vessels for carrying guns for "high angle" fire. I attach great importance to "high angle" fire; I think it is a thing we shall find extremely useful for dislodging a large number of vessels assembled in an enemy's port with these heavy guns in the smallest possible ships you can put them into. I am perfectly in accord with the lecturer about the system of training Officers and men; I think we over-educate them, having lost touch with what we absolutely require them to do, that is, to develop to the utmost extent the resources of the ships in which they will have to serve, and that can only be learnt and done on board with the latest—not obsolete—matériel. The State should only give such education as cannot be obtained elsewhere. With regard to the question of ships in the Reserve, again I entirely agree with the lecturer, that after a ship has been completed by the dockyard, men shall be put on board of her, and shall learn their "drill" on board that particular ship in which they are to serve. The present distinction between combatants and non-combatants should disappear. With that I most strongly agree. Every person on board ship should be a combatant (there is no

reason why he should not be so, it is only a sentiment), and should understand the use of the rifle, cutlass, pistol, quick-firing gun, and also elementary signalling. There is no doubt it only wants to be said and then it will be done! I am perfectly certain of that. Admiral Mayne says that the Volunteer "seaman gunner" should be abolished. I am very strongly of that opinion, and include the S.G.T. In order to obtain a smattering of knowledge (the time allotted to torpedo work will not admit of more), the "Volunteer seaman gunner" is kept in harbour on an average about a year. I am perfectly satisfied that every seaman should be a seaman gunner. We require captains of guns, highly trained men, also captains of torpedo tubes, and instructors in both subjects; but, when you think of it, it is ridiculous keeping men in a depot ship for a year on purpose to learn (with necessarily obsolete matériel) what they will possibly never be called upon to practise. With regard to the administration, that is a matter I will not touch upon. I do not profess to know very much about it, but I am satisfied we should have one head to supervise the passive as well as active defence of our coasts, arsenals, and ports, and not the division of authority which exists at present.

Admiral BOWDEN-SMITH: The interesting paper which we have just heard from Admiral Mayne goes over such a wide field and brings so many subjects to our notice, that I hardly know where to begin; and I have been still more confused by the remarks which we have just heard from Captain Cleveland, for he appears to agree with the lecturer that we have too much education, and yet that the naval Officer should know everything. You only have to say the word, and everybody on board ship will be able to do everything: navigate the ship, manage the engines, work the guns and torpedoes, know the signals, and everything else. I will, however, confine myself to the title of the paper: "Lessons to be learnt from Naval Manœuvres," and, as far as possible, I will restrict my remarks to the two questions that occur in the first paragraph. The lecturer mentions the "sad deficiency of most of our ships in those qualities which would be required in actual war." I conclude he alludes to speed and coal endurance. I think these naval manœuvres teach us the supreme importance of speed and coal endurance; and it would be only waste of time to speak of it, because all naval Officers are thoroughly alive to the fact. I do not think the public, however, are yet sufficiently instructed in the matter; I do not think the public in this country are sufficiently aware how very obsolete some of our ships are, and how unsuited they are for modern war purposes. To quote one or two—I won't mention ships like the "Glatton;" but in 1888 Admiral Rowley was put to blockade Lough Swilly, and had, amongst other ships, the "Neptune," which, though a powerful vessel in some respects, consumes so much coal, and stows so little, that she hampers any Admiral who is unfortunate enough to have her under his command. Admiral Sir George Tryon, in his report of 1889, writing of this ship, says: "She is a weak ship in her engines and consumes a coal-mine daily;" and of the "Hotspur" he says: "She carries very little coal;" and of the "Belleisle" he says: "This ship stops altogether if steaming against a head sea, and was never intended for fleet work at sea." Those ships and others like them are only fit for the protection of ports and for mothing torpedo-boats stationed at those ports. They can hardly be called efficient coast defence ships, for such ships to be efficient should be able to assemble rapidly on any part of the coast where they are required, and when they get to that station they should be able to keep the sea for at least a few days; they should be able to chase a ship off the coast; but these ships could not chase an enemy's ship off the coast, because if they did so, they could not get back again; they would have no coal left. I have noticed during the past twelve months that some of our public men, in talking to their constituents and others, have been rather inclined to disparage the wise efforts now being made to bring our Fleet up to a proper state of efficiency; and they have gone further and said that this great increase we are making to our Navy is a menace to other Powers, and that we shall have them doing the same. I think these manœuvres should teach such men that we are not making a very great increase to our Navy as regards fighting ships. We are only building a few new ships to take the place of those which are obsolete and entirely unfit for modern warfare. We are merely doing what every mail ship company

worthy of its name does, building new ships to take the place of the old ones, for if they did not do so they would carry no mails and get no passengers. Admiral Mayne alluded to the question of signalling, a matter of the utmost importance. In a country like this we must have ships, and we must have guns, and we must have men; but we shall not make the best use of those ships and guns and men unless we have also an efficient system of signalling and communication. It is of the most supreme importance that men-of-war should be able to signal to each other rapidly and correctly, and also to communicate with mercantile steamers and signal stations on shore, and that by night as well as by day. I am afraid that not very much progress has been made in that respect; but with regard to our Fleet, I think we may congratulate ourselves that there is a great improvement. Last year the supply of signalmen was very much better than it was in 1888; but still, as the lecturer says, much remains to be done. We are still short of men, and there was one 4,000-ton cruiser last year taking part in the manœuvres which had only one signalman on board. The Captain of that ship valued that man very much; it was said that he got a special waterproof suit for him, and that he gave him hot coffee in the morning and Bovril during the day, and so kept him on deck and efficient during the entire cruise. It seems that our brethren in the Army are paying more attention to signalling than we are. They have a Superintendent, or Inspector, of Signalling, and an Assistant Superintendent. We have nothing of that kind; and I submit it would be a very good thing if we had some Officer of the rank of Captain or Commander especially to watch over the signalling question, and the communication with the mercantile marine and land forces. He would then be able to see that signalling was properly taught, and that a uniform speed was adopted, that men did not make their signals too quickly or too slowly. When a number of ships get together, as at the manœuvres, you perhaps get a ship that has been three years in commission, everybody knowing their work, brought in contact with a ship that is just commissioned. The one ship has a smart signalman; and when he sees that the signalmen in the other ship are rather dull, he won't signal slower, but will do it all the faster in order to show his own superiority over the other men. In that way confusion arises; but if there were proper supervision, these things might be arranged, besides an Officer in that position would be able to see that the best sort of lamps were used. I thought last year that the lamps used in signalling might be improved, where the electric light was not used. Then, again, we should see that we are working with the Army, so that we could communicate readily in war-time. To show that looking after these things is necessary, I may mention that at the present moment the United States Army is not using the same system of signalling as the Navy; the Navy are using the same Morse alphabet that we are and that the Post Office is using; but the American Army are using another alphabet, and they are demanding that the Navy should use the same system as they do. I do not think they will, because the Navy think theirs is very much the best, and will stick to it. The Army say they are using the true American Morse; whereas the Navy are using the English Morse. I do not know how that may be—I see my friend Admiral Colomb is present who introduced the flashing system into the Navy—perhaps he can tell us. I was under the impression when we gave up his alphabet some years ago, although we are still using his numerals, that we adopted the true American Morse. I think one of the principal things that these manœuvres teach, or one of their great advantages, is that they bring a number of Officers together who otherwise would never know each other, and they are enabled to see ships manœuvred in fleets and squadrons, and also to observe the new ships and to watch their behaviour under similar circumstances of wind and weather. Last year we had nearly the whole of the "Orlando" and "Magicienne" class out. It gives us the opportunity of seeing more and learning more in five weeks, as the gallant lecturer truly observes, than we should do in three years on a foreign station. I wish to say one word with regard to the defence of my old ship, the "Britannia," because I entirely disagree with what the gallant lecturer has said about that ship. I would ask him whether he has visited the "Britannia," because I have found that some of those who have been most against the "Britannia," after staying a day or two on board, have changed their minds. He quotes the opinion of the last Committee that the system is faulty,

because the general education of an English gentleman is now cut short at thirteen. Now, the Admiralty, very wisely I think, have raised the age of entry to fourteen, and the boy remains two years, and, with the exception of classics, gets a very general education. They are not taken from school at thirteen now. Whether the age is quite sufficiently advanced, I cannot say; but I am very much against Officers coming into the Navy as young men. Life in the Navy is an unnatural life, and in order to accustom people to sea life you must begin tolerably early; I do not say you should begin at thirteen, that was too early. They were not boys, but children, and many of them had not got over their infantile complaints; the result was that when there was anything near the place, measles, whooping-cough, mumps, or anything else, we always had it on board the "Britannia." It only remains for me to say how much I have enjoyed this lecture, and I hope that the discussion that will follow will be of benefit to the Service.

Admiral Sir MICHAEL SEYMOUR, Bart.: As to what Captain Cleveland has said respecting sails, I would say that when I was in the Pacific, which is a station always quoted as one where sails are necessary, we hardly ever set them except for exercise, and had much rather have been without them, and this not only on the coast, but the Commanders of ships going round the islands came to the same conclusion. No one is fonder of sailing than I am, but the time has come when sails are no longer required, and I am afraid we must accept it. There are one or two points I should like to say a word on. One is as to the cruisers, and another as to the administration, which speakers do not seem to like to touch upon at all. I suppose we should not have heard anything about it if it was not to be touched on. It certainly is a very delicate subject, and I do not propose to go into it. I will only say with regard to responsibility in the Admiralty that I think you cannot have too much responsibility put on the Naval Lords. Everybody will remember the scare about the Navy when it was generally allowed and accepted in the correspondence which appeared in the "Pall Mall Gazette" and other papers that 1869 was the date at which the Navy began to go down hill. You have also this fact, that in 1869 we had the Order in Council of the 16th January, by which responsibility was taken away from the naval men, that is to say, responsibility to the country and to the Queen. Only the First Lord, a civilian, is now responsible, and the naval men are responsible to him. I do not say that one is the consequence of the other—that going down of the Navy—but I think it is a very curious coincidence that those two things should have happened at exactly the same date, and I think it is deserving of more attention than it has received from the public and from naval Officers. Then as to the cruisers. The lecturer, I think, said that he was entirely for lengthening the cruisers, and that the shortness of those ships was a very great reason why they could not steam against a head sea. It is, I think I may say, the sole reason. We have these large liners going across the Atlantic, going over in six days, and the reason they go over in so short a time is simply because they are long. I do not say you can build a man-of-war like the "City of Paris" or the "Umbria," because the conditions under which we build our vessels are totally different as to weight, &c., but you can go on the same principle and make them longer. You cannot go against a head sea with speed unless you make them long. Of course there are all sorts of objections, and one of the principal objections put forward is the question of manœuvring. I do not think anything of that at all; I think really there is very little difference between a ship 300 feet long and one 400 feet long, and as a matter of fact I am told the "Anson" takes as large a space to turn in as the "Minotaur." The real question is not one of manœuvring; it is entirely a question of money. I had a casual conversation with my friend Mr. White. I said to him, "With regard to the 'Orlando' class, you seem to me to have entirely spoilt them by making them too short; they stop dead in a head sea." I said, "They ought to be brought out 25 or 30 feet at each end." He said, "Yes, but then you make a larger ship: you must have more displacement, and that costs more money." That is just it. I do not consider that Mr. White is to blame. Mr. White, I take it, is the servant of the Board, and he has to design ships according to order; but it seems to me that instead of starting by saying that you are only going to pay a certain sum, and then getting as many guns as you can into the ship, you should start and say what guns she is to carry,

and then make her as big as is requisite. The only other point I would touch on is that of entrance into the Navy. I am entirely with Admiral Bowden-Smith in hoping the "Britannia" will not be done away with. I think the lecturer said that he was entirely for open competition. I do not know whether that was for the benefit of his constituents or for naval Officers; but I am dead against open competition, in fact I am dead against competition at all. Have a test, and make it as high as you like, but do not go to open competition. At all events we have now nomination, and that is a great security. It seems to me we should keep up the old traditions of the Service, and to do that, it is essential that you should have nomination, by which means you secure having Officers who are gentlemen born and bred.

The CHAIRMAN: As the question of sails has been discussed, I may say they are to be abolished; the fiat has gone forth.

Captain LONG: Looking at the ground covered by this paper, I cannot but congratulate the gallant member, whose constituent I happen to be, on having so carefully gone over the whole subject. I do not propose to attempt for one moment to follow him over all this area which he has touched upon, but I should like to remark on one thing which appears to me to be the main lesson of the manœuvres, namely, the importance of speed and coal endurance. I would particularly do so, because it has happened that in two of our very important text-books a statement has crept in, which I do not for one moment ascribe to the authors of those text-books, but as being supposed to be the expression of naval opinion at the time, based necessarily on peace experience only, and that is to the effect that a man-of-war is only required to go at full speed for a short time and at long intervals. Now I think we naval Officers must be most grateful to the Government of the country which has brought about these naval manœuvres. Those who recollect what was going on ten years ago will recollect most distinctly that we did not know the capabilities of the new ships, or what they could do or would have to do. One thing that these naval manœuvres have done is that they have utterly exploded the idea that a man-of-war only needs to go at full speed for a short time and at long intervals. They have brought out most clearly the importance to us of having ships that can keep up full speed. You might just as well say that a hawk does not want any wings when you see him shut up, because he is then fed with meat, as that a man-of-war only wants to go for a short time at full speed. Naval Officers on a ship kept shut up in harbour do not know what they want; but when war comes they will have to do what the merchant ship has to do now, that is to say, to fulfil the object of their existence, and that will involve going at full speed for a long time and constantly.

Admiral SELWYN: I am delighted to hear so much confirmation of views which were advanced by me some fifteen years ago at the Naval Architects. Naval Officers were then called upon by the late Mr. Scott Russell to lay down the requirements of their ships, and a great many did it. I do not know exactly their views, but I put down speed, and what is now called "endurance," which I called like as in a racehorse "bottom," "lasting power." I then set myself to work to discover the fuel by which this might be done. I knew very well that speed could not be kept up until we had the right fuel, and those who know me know how many years I have laboured to show that not only can new ships be provided with speed and with great endurance more than they could reasonably require in going at high speed from one place to another, where a fresh supply could be had, but that all the old obsolete ships can very easily be brought up to modern requirements where they are not of such effete construction as sea-going or sea-keeping vessels that they had better be broken up for old iron. There is an error which many people make in calling the thing which I have always advocated "liquid fuel." Liquid fuel was talked of a long while ago by Mr. Malet, a very eminent engineer; but I have found and exhibited new principles by which gases are burnt with and alongside of fuel. I therefore call it "fluid fuel," because all gases are fluid, though all fluids are not gases. The supply of oil by distillation from coal is a very good idea if we do not happen to have any other; but in the shale field extending under the island of Portland first of all we have enough for the Navy for the next 100 years,

capable of giving by convict labour 60 to 120 gallons of oil per ton; and then we have a bed extending 670 feet thick and 10 miles wide across all England right to the coast of Norfolk. There is more available fuel in that bed than ever there has been in all the coal fields. With regard to the manœuvres, all naval Officers will join with me in saying that speed is one of the chief factors of all manœuvres. If we do not have the speed and bottom, of which we have been speaking, or speed and endurance, it is folly to classify a fleet by the size of the ships, the number of guns that they carry, or their importance in any other way. If we have in a squadron or fleet one bad ship that cannot go more than 8 knots, or keep up her fuel supply sufficiently long, the speed of a whole fleet is reduced to the speed of the lame duck. The manœuvres too are very nearly dependent on whether all the fleet are possessed of twin screws or single screws.

Admiral Sir GEORGE WILLES: All the ships have twin screws; we call them double screws.

Admiral SELWYN: That was the old name given to them by the inventor, Richard Roberts, and advocated by the late Captain Symonds and myself at the Naval Architects. Captain Symonds and I took the question up many years ago, and I hope it is now settled. The classification of ships I maintain ought to be by speed and endurance. If an Admiral is wanted to do certain work, he must be given a fleet fit to perform that work; he cannot perform it if he has all classes of vessels mixed up in his fleet or his squadron. Naval volunteers, as sailors, are getting further from us every day. Every day, more and more, the Navy is becoming a special profession. The knowledge must be so varied and so accurate on certain subjects that no mere knowledge of the sea or of seamanship is sufficient to enable persons to take part in it; and we shall have in all probability to divide that knowledge up into classes more than we have yet done. I think that of all the papers I have had the pleasure of hearing read at this Institute, I have never heard one more calculated not only to open up a large field of enquiry, but to indicate, though only indicate, true methods of dealing with it. When we talk about stokers as combatants, it is very difficult to do away with the fact that you can only get the stokers off watch; that you must have the others down below, and perhaps sometimes almost all of them hard at work at their fires, so that they cannot possibly be otherwise employed on deck. The beauty of the fuel which I proposed is that you need no stokers whatever, or coal trimmers, or anybody else connected with the fires; the engineer can control it all and decide how much to burn. The question of the water-line belt connected with the defence of the ship can be solved in only one way. No one can ignore the fact that the water-line is a fearful danger if pierced by modern projectiles. If the belt is to be done away with, some efficient remedy for that danger must be found, and that efficient remedy is to be found in combination with a more perfect efficiency in the use of hydraulic propulsion. The instant that is used, we may have any number of engines we please and do away with the need for sails which have been hitherto talked of as the sole resources in the case of ships breaking down, because it is not probable that six pairs of engines would all break down together. The engines can be much smaller, and we have a knowledge of the power of the revolutions of these engines lately, according to Mr. Parsons, which makes it utterly undeniable that the steam turbine is the coming engine. When you get up to 12,000 revolutions a minute, which is constantly going on now, you have the true means of propelling and pumping at one and the same time. You can also meet to a certain extent the question of water-line by cellular construction; but everyone who knows what a ship is, will know perfectly well that cellular construction may also be carried too far; you may make it impossible to get from one part of the ship to another. With regard to the forced draught, I was very much pleased to hear what the lecturer said. It is the greatest economical mistake that has ever been made, and it is accompanied with very great danger, as we have seen lately in the case of the "Barracouta." There is a well-known fact that if we mix air with combustible gases in the proportion of between nine and thirteen parts of atmospheric air with one of combustible gas, we shall make an explosive mixture, and we may get a flame or an explosive which will destroy a ship, simply by not being able quite to control the exact quantity of air that ought to go in. Absence of masts and yards can be very well excused if you

have a number of independent propellers ; but I should not like to do it without them, because everybody will see, as we are at present, we have twin screws and two sets of engines ; but it may be, it is at least possible, that both these should break down together. It is still more possible that the boilers may give way under higher pressure. Does any one propose to send a vessel, or a fleet of vessels, to sea with no power of locomotion after such an occurrence ? Some means we must have. I do not prefer sails ; but I do prefer that we should consider the question closely and provide for it in the best possible and the most advanced way. In the case of education and training, I would like the meeting to remark that every specialist has the greatest faith in his own particular training, and that if you were to hand over to a schoolmaster boys from the age of 8 to the ages 17, 20, or even 25, he would not say it was at all too long. But it is on board ship alone that a sailor can get familiarity with his work. It is all very well to teach him up to the age of 14 or 15 ; I should prefer 13 rather than 14 on shore or in harbour. There he ought to be principally kept to learning those parts of his duty which relate to the workshops, very little indeed of the higher work of the gunnery, &c., which he would be called upon to practise later, but a great deal of hammer and chisel work, a great deal of knowledge of the use of tools which he won't afterwards have to use, and a great deal of hard work to keep him out of dissipation. If you allow any specialist, I do not care how good he may be, to lay hold of you with the idea that he will want all the attention of every boy from childhood to twenty-five, I do not think that can be done usefully for the Navy—where discipline is a paramount consideration. I think the workshop is the place, and I am quite sure having got the boy to choose a line which he prefers and shows aptitude for, you may in great measure separate them into men designed by Providence to do certain things. You cannot make an engineer by putting a brass plate on the door. God makes the engineer ; God makes the telegraphist ; God makes the electrician. The God-made man will be an expert in the special art ; the others will do nothing at it. Choose them out early, put them to do their proper work, and then insist on their knowing it thoroughly and forming schools under them of similar boys.

The discussion was then adjourned on the motion of Admiral Sir GEORGE WILLES, to Tuesday, 25th instant.

ADJOURNED DISCUSSION.

Tuesday, February 25.

ADMIRAL SIR R. VESEY HAMILTON, K.C.B., in the Chair.

Admiral Sir GEO. WILLES: It is impossible that anybody can do justice to all the questions contained in the paper. I have therefore selected a few, and I commence by referring to rather a delicate subject by suggesting that that part of the paper which relates to the administration of the Navy should not appear in the Journal. In my opinion the discussion of the administration of the public services is beyond our province altogether. But I must say that I do not agree with our gallant lecturer, for, in my opinion, the administration of the Admiralty under the Patent is the very best system we could possibly have. If the Naval Lords of the Admiralty are independent men and true to each other, their power is very great ; and it is well known that Lord Hartington's Commission has approved of the Admiralty administration and suggested it for the Army. Now about the manœuvres. There cannot be the slightest doubt that they have proved a success ; but I do hope that in the future the system of raiding towns and capturing merchant ships will be forbidden. It turns the whole thing into ridicule ; there is, however, a dark side to the picture. As I understand, during these manœuvres all gun drill, all exercises, all steam tactics, are at an end, and there is nothing for the men to do but to coal the ships. The Officers, on the other hand, are gaining

a great deal of experience. There is still another great objection, as I believe it will be found impossible with our present strength of the dockyards to keep the ships in proper repair. We had a very able State paper drawn up by three Admirals two years ago, and I am proud of the authors of that paper. It is well known that one of them is now in the chair. In that paper they have pointed out that no ship should be taken credit for until she is in all respects ready to go to sea and fight. What is the present position of affairs? There is scarcely one ship in that position. At any rate, the ships that have been repaired and are ready to proceed to sea may be counted on the fingers of one hand. Henceforth the most important consideration will be the care of all these large ships which are to be built and kept ready in the state described by those gallant Admirals. This is a very serious business. The only way to maintain our ships in the First Reserve is that after the manoeuvres they should be immediately repaired and turned over to the Commander-in-Chief, who must be responsible that they are kept efficient. I have heard some lecturers, and I have also heard Officers outside, say that they should have their crews on board. Now, I went carefully into that question. There are a great many difficulties to be considered relative to discipline, fire, short days in winter, and climate. At Toulon the climate is much more suitable, and there can be no objection to the men and Officers being kept on board. I suggested that depot crews should be selected, with a certain number of Officers to take charge of the men, to be marched on board in the morning to look after the guns, machinery, and so on, and then to return to barracks in the evening. Our gallant Chairman the other day rather astonished me by announcing that the fiat has gone forth that ships are no longer to have masts and sails. The general introduction of twin screws made this inevitable, for there can be no real reason for keeping masts and sails in twin screw ships, except as a gymnasium; but I do protest against removing them from our "boys' training ships," our training squadrons, and from ships which may still exist with only one screw.

The CHAIRMAN: It is not intended to apply to those ships—simply to the ships of the future.

Admiral WILLES: Then I leave on record what I have said, because that meets my views. If masts and yards are abolished, can there be any reason for not abolishing the "volunteer seaman gunner"? quoting Admiral Mayne's words. I concur with what he has said on this subject, and the Board of Admiralty in 1879, of which the gallant Officer behind me, Earl of Clanwilliam, was an honoured member, decided the change should be made . . . but vested interests and passive resistance were brought into play, and the evil still exists. I have given my opinions upon the question in this theatre on other occasions, and will not enter upon them again. I was glad to hear Captain Cleveland's opinion on this subject, for he is an expert, and has just left the "Cambridge." It is an open secret that about 90 per cent. of the Officers consulted by Admiral Bosanquet's Committee were in favour of this change, which must come about in spite of all opposition, and the sooner the better. I now come to the question of torpedo-boats and torpedoes. I quite agree with the lecturer, and I do not believe that the torpedo will ever form an important part in *offensive* warfare. We cannot, however, withdraw torpedoes from our ships altogether as long as they are maintained by other nations; but I certainly think that they should only be used when they can be fired submerged. The idea of firing them otherwise under the frightful fire which would be produced by the quick-firing guns is to me absurd. The great question in this theatre used to be the gun, the ram, and the torpedo. Where is the ram? Gone. Our lecturer said the other day that you cannot get speed without length, and so those small ships, "Wasps," which Sir George Sartorius used to advocate, are out of date. Well, the torpedo has lost ground, and our good friend the gun is more powerful than ever. Admiral Mayne couples a deficiency of Officers of Lieutenant rank with a deficiency of stokers. No doubt the training of the stoker is a very easy matter. Our gallant Chairman can remedy that difficulty. I stated my views on this subject last May. You can get stokers in course of time, but they must be trained. We have no training system. The Italians have a good one; and I have no doubt the French also. It ought not to be a question of expense (and we know that money is not tight just now). As to the increase in

the number of Lieutenants, it is a very serious subject, and I do hope that by introducing more Officers of the Naval Reserve, and increasing the number of Warrant Officers, under instruction for navigation and pilotage, we may avoid the necessity of increasing Lieutenants' lists. Warrant Officers could be employed in our torpedo-boats and gunboats in time of war, so that our Lieutenants may go to sea. If you increase the number of Lieutenants, how are they to be promoted? It is sad enough now, and it is no use looking forward to any increase of the higher ranks; at least I think so. Therefore I do hope that the ranks of the Lieutenants will not be sensibly augmented; for by and by a cold fit will come on as usual, the number of ships will be reduced, and then we shall have a number of these most valuable Officers on half-pay. The lecturer has alluded to the conduct of the Naval Reserve. I do not attach much importance to the "Trent" affair; it is quite a matter of ancient history; but we must not forget that directly war is declared, the Naval Reserve men come under the Discipline Act: they must come forward. I do believe that the villages and towns in which they live will make it too hot for the defaulters. Under the head of the "personnel," I cannot concur in all that has been said by Admiral Mayne. I have on two occasions given my opinions in this theatre. No doubt there is much that is faulty in the education of our Officers—I only allude to the Executive. To take a young Sub-Lieutenant away from his ship at the age of 19, to pass 18 to 20 months in Portsmouth and Greenock, cannot be for the good of the Service. In fact I know it is not, and I hope the system will be modified. Now as to open competition. Well, I am afraid it will come sooner or later, and I hope later, for it will be an evil, for reasons which cannot well be expressed in public. Admiral Mayne proposed to do away with—I won't call it the "Britannia," but with our Royal Naval College. I am sorry the word "Britannia" has not been dropped. It is a floating naval college. In the Army the young men who are successful in the competitive examinations are sent to Sandhurst and Woolwich for a course of study and discipline before they join their different corps. Why then should our admirable Naval College be abolished, and young men at the age of 17, 18, or 19 be embarked direct? I pity the poor Captains, and I pity the Navy. No doubt there is one evil in the Naval College, namely, the expense, but this might easily be reduced. In the Naval College, with which I am proud to have been connected, the civilians had to pay what was then considered a large figure, 120*l.* per annum, for their sons, whilst naval and military Officers paid according to their rank; but in the "Britannia," I believe—Admiral Bowden-Smith will correct me if I am wrong—they all pay alike, about 80*l.* a year, so that gentlemen well off send their sons there for the same figure as naval and military Officers. I believe that this will lead to great abuse. Many men will say, "Oh, it is a capital thing, it is the best public school in England,"—and so it is without exception,—"I will send my boy there, and pay 80*l.* a year for him. I cannot get him educated anywhere else under 150*l.* or 200*l.*: then when he has been there for five or six years the Navy won't agree with him, or he won't agree with the Navy, and he will come on shore."

Admiral BOWDEN-SMITH: A limited number are taken on at 40*l.* I cannot sit down without alluding to our Chairman, whose appointment as Senior Naval Lord has met, I believe, with the general approbation of the Service. He is not only able, but he has advanced and liberal views, and I am quite certain that he will do his best to carry out the possible changes advocated by Admiral Mayne. It will be a laborious task, but I am sure he will have the moral support of the Officers of the active Navy, and the good wishes of the retired Officers.

Captain W. ST. JOHN S. HORNBY: I rise with great diffidence after the distinguished Officer who has just spoken. My words, at any rate, will be very brief, and I hope they will be to the point, for they will be confined to this lecture. The first point is this about Open Competition. This is the first time, I believe, it has been broached here, but I had the pleasure twenty-two years ago, or more, when I was a young Commander, of mooted this same subject at the Naval College, and it was scouted, as it will be to a certain extent now. I think that open competition, properly brought forward, will be one of the best things for the Navy and for the nation. I believe, if open competition in that way were given to all the big schools, Eton, Harrow, and so on, it would be a grand thing for the Navy, and I think you

might extend it to all the grammar schools; and then, if the Admiralty would give facilities in the way of scholarships, you would get classes formed at the schools and colleges; but unless such facilities were given, the head masters would not take the trouble. By open competition I think you would get the bone, sinew, and brain of the nation. But even if that does come about, I should not by any means do away with the "Britannia." I think the "Britannia" is one of the best institutions that ever has been invented and carried out, but I would give the open competition so as to prevent it becoming more and more the custom that all the nominations and appointments should be in the hands of politicians. The First Lord, for instance—I speak with deference, of course—has a great many appointments, and the politicians are getting the whole thing into their own hands, whereas, by open competition, you would get just as good fellows as you do now in another way. An Officer spoke at the last discussion on this lecture about the naval families, and so on. Well, some of these naval families have had a very good "innings;" but I think that all monopolies should be done away with. I will not touch further upon that subject, but will refer to the question of every one in a ship being a "combatant." It is very pretty on paper—but take the case of the stokers; how is it possible for any one to make a stoker a combatant? I am here reminded by Sir William H. Stewart that in the ship I served in, under his command, all the stokers were trained, but those were pre-steaming days; there was not the steam power in ships in those days that there is now. I should like to know from Officers who have been employed during these late Naval Manœuvres, whether they had any chance of sending the stokers on deck? Is it not rather the case that, if you are blockading or chasing the enemy, or engaged in operations of that kind, you have to send your deck hands down below, in order to keep the fires going, so that the training, on board a man-of-war, of the stoker, is simply a waste of time, and employing your Gunnery Lieutenants and instructors absolutely to no purpose? It takes half the naval lifetime to make a man a perfect swordsman. It is absurd to waste your strength in that way. If your stokers were entered young and trained up as stokers, and you had them in barracks all ready to put on board ship, I grant that something might be done in that direction. Another thing in connection with the stoker is, that he believes that he ships for a certain purpose, *i.e.*, for stoking, and stoking only, and he does not understand when he is shipped that he is to be bound by the Naval Discipline Act or Mutiny Act, is therefore obliged to do everything that he is told, and be away from home three years. That is one of the reasons why stokers hesitate to embark in the Navy, and makes the shipping of stokers for the Royal Navy difficult. Another point with regard to all persons in the Fleet being combatants is this—take the Paymaster branch. It is comparatively easy, of course, for one who studies hard to master the principles of book-keeping, but it is more difficult to put them in practice. I should be very sorry, if I was a Captain of a man-of-war, to be answerable for all the accounts unless they were kept by a person who had gone through a regular training. Book-keeping is an art, and a person must be always at it to understand it and do it thoroughly. Would commercial men, in large firms, doing a large business, leave their books in charge of a man who is always going to balls, parties, and all manner of things? Of course they would not. But that is done in the Navy, and I venture to say that in the occasional scandals which have cropped up of late, you will find that the men who ought to have looked after the book-keeping were always slipping ashore to tennis parties and all manner of things.

The CHAIRMAN: This hardly bears upon the point of the manœuvres.

Captain HORNBY: I think, Sir, that I am in order. What I want to say is this, that men who have the particular education ought to stick to their own peculiar work. In order to carry on book-keeping a certain training of mind and temperament is requisite, and it should be in the hands of those who have made it their business to study and practise it.

The CHAIRMAN: I do not think that is quite relevant to the subject, "Lessons to be learnt from Naval Manœuvres."

Captain HORNBY: I think it is one of the points. Reference was made on Friday to "every one being a combatant;" Lieutenants giving instruction in navigation; a Lieutenant in the stoke-hole, and so on—

The CHAIRMAN : No ; I think not.

Captain HORNBY : There are some very excellent naval instructors, but they are not all able to impart to young Officers the knowledge they themselves possess. They are not all the same as Professor Laughton, and I think, considering that the naval Lieutenants of the present day have such a high standard of education, they might very well take that part of the duty, and thus we should have an additional combatant Officer in the sea-going ships. With regard to the administration of the Navy I will not say a word ; it is not in my line. I have my opinions the same as most of us ; but with regard to the ships I think I might say a word. I think if the commission of the ship were shortened it would be more to the contentment of the Service. Everybody knows that the happiest part of a ship's commission is the first two years —

The CHAIRMAN : We are not learning that from the naval manœuvres. We want to discuss lessons to be derived from naval manœuvres, and certainly that is not one of them.

Captain HORNBY : As regards the ships, the fiat has gone forth that masts and sails are to be done away with. I venture to say if ships were built more for special purposes, that is to say for particular stations, it might be better for the Service. Each station requires a particular type of ship, in accordance with the naval base of operations and coaling stations, and it appears to me that if masts and sails were at once done away with at foreign stations, it would not be altogether an advantage —

The CHAIRMAN : Before we go on with the discussion, may I make one remark ? We have a very comprehensive lecture to consider, and the title of that lecture, as I have said, is "Lessons to be learnt from Naval Manœuvres." One of those lessons can hardly be the point as to whether ships should be two years in commission or not. I hope that we shall not wander away from the real subject before us.

Admiral BOYS : I will premise by saying that our lecturer has given us an extremely good paper, but I think he has mistaken the title. The title is, "On Lessons to be learnt from Naval Manœuvres." Now, when I came here I expected to hear something about manœuvres, a description of what happened, or the strategic movements of the fleets : but I have failed to discover anything on those subjects. The paper deals with the general organization of the Navy. Many points are touched upon which are very valuable. Before referring to some of them I may say I feel I ought to apologize for rising to speak at all, because I consider it is far better in this Institution, as a rule, that the speakers should be those who are in the position to command our ships and command our fleets. Their opinions must be more valuable than those of the majority of us who are sitting on this front bench as retired old Officers ; and although occasionally we may do some good in giving our experience to those who come after us, still I really think that it is desirable to give the greatest scope to such men as most of those who have already spoken. Admiral Mayne has touched upon the seaman gunner. I know the question of seamen gunners to some people in our Service is like holding a red rag to a bull : if you mention a seaman gunner they will start up to decry him with a view to his being abolished. Now what is a seaman gunner ? A seaman gunner in my days was, and is now, a man trained and drilled beyond other people, and he receives extra pay for extra qualifications. He has to know everything connected with his drills, and besides that he is to be an instructor. One of his especial duties is to instruct other people. It is said that everybody should be a seaman gunner ; undoubtedly he should ; but that is a practical impossibility ; every seaman cannot reach the standard required. What is proposed is that you are to have men to be captains of guns, of turrets, quick firers, to give instruction in gunnery, rifle, and cutlass, and everything else, and these men are all to be trained for the purpose, but they are not to be called seamen gunners ; in fact you are to have twelve pence instead of one shilling. It seems to me to be an anomaly. My connection with seamen gunners commenced just forty years ago ; and I must say, from my experience, it would be very detrimental to the Service if the seamen gunners, as a class, were done away with. We must have a body of men of that description. What happens now ? I appeal to any Captain or any Admiral, who are the men

that he looks to—especially on first commissioning—as the nucleus of his ship's company to fight the ship, but to the seamen gunners? If an Admiral inspects a ship, in all probability he can pick out every seaman gunner by his appearance, by his general bearing, and, as a rule, by his superior intelligence. Sir George Willes says the seamen gunners are kept in harbour longer than other people; this I much doubt. I think it would be a sad mistake to employ such men as is intimated in the paper, in cleaning ships' double bottoms, &c. I think they are far better engaged as they are now, whether on the "Excellent" or the "Cambridge," or on shore in barrack perfecting themselves in their drills, and making themselves competent to teach others, because gunnery Officers and seamen gunners learn more of such duties, while in "the manual" after they have passed through the instructional course. Seamen gunners must be good seamen before they go through their qualifying instruction at all; if they are not, it is the fault of the Captains who give them their certificates. No man could qualify as a seaman gunner in my day until he had a certificate to say that he was a good seaman; therefore I should be very sorry indeed, and I am certain it would not be for the good of the Service, if ever the rating of seaman gunner were to be abolished. You may call him what you like, seaman gunner, or instructor, or anything else—but men of that class you must have. In peace-time we probably may have more of these men than are necessary, but we must remember that we have to legislate not for peace but for war. What will happen immediately on the declaration, or probable declaration of war? The gunnery ships will all be shut up: the seamen gunners will be distributed over the whole sea-going fleet, and when you have distributed them to every ship in commission and about to be commissioned, you will have none too many, and they will be extremely valuable wherever they may be. In merchant-ship cruisers especially a few seamen gunners would act as captains of guns, would assemble the crews round them, instruct and drill them at the guns that they may have to deal with. I have a very strong feeling on this question. My friend Captain Cleveland I know is a man for putting his foot down, and, when he does put his foot down, those who are under it feel the weight of it; but that does not imply that he may not make a mistake sometimes—and I believe him to be wrong in this case. Merely giving the order will not make men efficient in acquirements for which they have not the capacity. There is another point which I should like to touch upon—the entry and education of our young Officers. To a great extent I agree with our lecturer. I maintain it is not necessary that young gentlemen of the present day should be educated generally at the expense of the State in an expensive establishment afloat. What does the education consist of? I myself have had a boy in the "Britannia," and a nephew in the "Britannia," and another at the same time in a public school. The course of instruction and the curriculum were very nearly the same; even the school bills corresponded. Why should the Government undertake the education of these young gentlemen? I do not see why they should at all. And then as to entering at so young an age. I quite agree that in former days when they went to sea, especially in small craft such as brigs and schooners, at twelve or thirteen, they had many hardships to endure, it was necessary that they should enter early in order to be broken to the life. But there are no hardships now-a-days. There might have been a little hardship accidentally a week or two ago when more youngsters were sent to take passage in a ship than there was accommodation for; that was exceptional, and they were none the worse. In my opinion no boy should join the Navy till he is sixteen. No doubt my friend Admiral Bowden-Smith is quite correct when he believes that the "Britannia" in his day was everything that the "Britannia" ought to be. At the same time I maintain she is a mistake. She is nothing but a public school, and no school, as a rule, can be a success when the head master is changed every three years, as is the Captain of the "Britannia." Then, again, the boys being under naval instructors for education, and combatant Officers for discipline, is inconsistent. They cannot be Officers and schoolboys at the same time. The Chairman reminds me my time is up, so I must stop.¹

¹ I intended to add that I do not believe in entry into the Navy by competition, and competition at the age of twelve or thirteen is no criterion of what a lad may

Admiral Sir HOUSTON STEWART, G.C.B. : I should be glad to say that I have listened to and read with great pleasure the very able, clever, and instructive lecture delivered by my gallant friend Admiral Mayne. I have never heard here or anywhere else a more clear and able address. I cannot attempt to range over such an extensive field for discussion as he has presented, comprising as it does the whole constitution and policy of the Navy. I will only attempt, in compliment to my gallant friend, and to show him that I have read his paper with care, to glance over a few of the many points that he has raised. I quite agree with him in not believing that our brother Officers sit in Whitehall in ignorance of what they would do in case of war, although they are obliged to maintain a careful reticence, involving as it does the consideration and approval of the Prime Minister and the Cabinet. I am glad to see in this paper that fortifications are recognized as being of real use for the protection of our dockyards and our ports. I have never been quite able to understand the drift of some interesting papers and discussions that have taken place in this Institution on that subject, but I must say my own opinion is that no Power can be considered as a first-class Power whose dockyards and arsenals are not protected by sufficient fortifications, and the approaches to whose commercial towns from the sea are not rendered reasonably secure from the acts of raiders, nor can any Power be justly entitled to maintain the title of a first-class Power whose naval and military forces are not capable of ready expansion and organization in time of war. I think my gallant friend's proposal about a Commander-in-Chief having a "standard" is an admirable one. It has been proposed and discussed before at the Admiralty, but during the time I was there it was never possible to meet with a general agreement on the part of the Admiralty and the House of Commons as to what the "standard" should be. I quite agree that it is of the utmost importance to maintain our battle-ships at their full efficiency, and that the standard of battle-ships should never be permitted to fall below what would enable us to have reasonable security in the event of war with two maritime Powers. But to my mind the paramount consideration is that we should maintain, not only in war but in peace-time, on every sea where our commerce is found, efficient cruisers. When I speak of efficient cruisers in time of war, I take as a type, as near as they can be approached in the design of a war-ship, our first class ocean steamers, that they should be able to go anywhere, in spite of wind and weather. All others I relegate to the duty of defending harbours, estuaries, and acting as scouts. When our great pitched battles in the past were fought, if the world of the sea had not been covered by our cruisers, the cruisers of the enemy might have worked their wicked will on our commerce. Where then would have been that financial credit which alone enabled our great Minister of that particular day to provide the sinews of war, without which those great and prolonged struggles could not have been continued? With reference to the seven lessons from the naval manœuvres, which our gallant friend has drawn, the first is, "that the official speeds of ships are unreliable data." That is perfectly true. The second, "that commercial depôts and their approaches cannot be adequately protected by passive defence alone." I do not quite understand what that means. Third, "that speed is a most necessary factor in a war vessel." That is undoubtedly so, and to me it has always been the first consideration ever since I could form an idea on the subject. To maintain speed at sea, you must have length of ship. "Next to it large coal endurance." In that I entirely concur. When Controller I always endeavoured to increase the coal endurance of our ships. "That the maintenance of a squadron with coal stores, &c., requires special and careful organization." Undoubtedly it does. "The mystery attached to the movement of ships and their object should be abolished, so that everyone concerned should be induced to take an interest in them." I do not quite understand this. If it means that the movements of the ships and the

be even three or four years later; it is incongruous, and only one remove better than putting the names of the candidates in a hat and pulling out the lucky ones. The proposal I advocate is to give nominations at the age of thirteen or fourteen, and inform parents there will be a test examination at sixteen or seventeen, when they would be sent direct to their ships. This system would have many advantages.

affairs of the Navy are to be known to the public, I think they are quite known enough already. And lastly, "it was most evident that the squadron were deficient in cruisers and scouts." There are no two opinions about that. Those are the seven lessons that the lecturer gathers from the manœuvres. I venture to express my opinion that the time taken by the Torpedo Lieutenant is far too short for him to learn the trade of an engineer, and he cannot direct others unless he is master of the subject himself, which requires both theoretical and practical knowledge. I quite agree with regard to the non-combatants, that the firemen or stokers should be trained to the use of guns and arms. I have been in three paddle steamers, and one three-deck screw ship, where all the firemen and stokers were trained for battle. In the "Fire-brand," which had four 10-inch broadside guns, partly manned by the firemen, when the ship took part in the bombardment of Sebastopol, and on other occasions, this proportion of firemen stationed at those guns worked them during the action. The time is much too short to enter into the subject of the Second Class Reserve for the preservation of ships, but I do not think it would be advisable to allow half the crew to be embarked under a Lieutenant. It seems to me that this would be too large a number of men practically in harbour ships, and with not a sufficient staff of Officers, they will deteriorate, and discipline will suffer. With respect to the question of no organization for coast defence, which is remarked upon by Lieutenant Colwell, it is well that we should see ourselves as others see us. It undoubtedly is the case, and I cannot understand how our coast defence can be ever perfected under the purely voluntary system. Until it becomes the enforced duty of every man who makes the sea his profession, or carries on his trade around the sea coasts, whenever called upon to be obliged to take part in the defence of his country, I do not see how that organization can ever be what it should be. With reference to the administration of the Navy, one of the great difficulties of Admiralty administration is the conflict of naval opinions. I do not know any greater, and I think we have a specimen of that here with reference to what has been said as to whether the "Britannia" should be done away with or not. And here I will venture to remind the able lecturer of what appears to be a contradiction. He speaks, no doubt most properly and deservedly, of the proficiency of the younger officers, as shown during the manœuvres, in contradistinction to the non-proficiency of the material or ships. That would rather argue that the young men do come from the "Britannia" well prepared for the work they have to perform. Another of the differences of opinion is a very important one. Admiral Mayne has quite decided to do away with the side armour of ships. We know that other Naval Officers, whose opinions are very valuable, are strong on the contrary for its retention. As to the question of guns, I have no doubt my gallant friend is as well acquainted as I am with the difficulties other countries have had in the manufacture of these novel and large guns; they have had as many failures as we have. I know also that they have had accidents as serious, so far as the efficiency of the gun is concerned, and much more serious in the loss of life caused. I rather fail to see how the civilian head of this revised Ordnance Department, with a sailor and soldier to help him, will put us in a better position than we are now with such an establishment as Elswick, as well as Woolwich, and the possibility of having whatever naval or military Officers may be selected, to assist in gun designing and manufacture. The lecturer has remarked on the extravagance of the system of repairs, which he thinks will be rectified if it were put into the hands of the Commander-in-Chief of the port. I have had a good deal to do, in the dockyards and out of them, with the question of repairs to ships, and I could dilate for a long time on the subject, if time and your patience permitted. I am not going to do so, but only to say I fail to see why, supposing a ship is repaired at Portsmouth, the repair should be more economically carried out under Sir John Commerell, the Port Admiral, than it is now carried out under Admiral Gordon, whose special attention, as Superintendent of the Dockyard, is directed to the repairs and nothing else. I have no time to say more; it may be the outcome of an old-fashioned sentiment, but I do feel,—able, instructive, and clever as this paper is, and there are many points in which I agree—some misgiving as to whether some of the subjects of this lecture, so clearly expressed, are suitable for discussion in this Institution.

Lieutenant BADEN-POWELL, R.N.R.: In attempting to make a remark or two on such a question as this, and with such high flag Officers present, of course it will be my duty to keep as clear as I can of criticizing the technical subjects of the ironclads engaged in the naval manœuvres. But, in reading the lecture, one thing struck me very forcibly, and that was in regard to the action in the naval manœuvres in which the ships chased the merchant steamers and captured them of untold wealth, something like Ali Baba did the cave in the "Forty Thieves" story. Sir George Wiles said that this was perfectly nonsensical, or words to that effect, and I quite agree with him; from the sailor's point of view there is nothing more nonsensical that has transpired in the naval manœuvres than putting down on paper that certain fast merchant steamers were captured as prizes. I should like to have seen where those cruizers would have been after chasing for twenty-four or forty-eight hours: they would have been a long way astern. But there is another way of looking at that, and I think the Government, perhaps, is right in allowing this chasing to take place, more especially in allowing the printing thereof to take place, and that is, it gets the money out of the House of Commons. That is the way I look at it, and if you can have a little by-play, which keeps the House of Commons and the British public amused, and gets the money into the naval locker, then I say it is justifiable. The subject of the Declaration of Paris has been just glanced upon in this paper, and though I have once or twice in this theatre spoken upon the Declaration of Paris, and hold strong opinions upon it, I think it is a long time since the country has had a large naval funeral, and I think the sooner a small naval funeral is organized, in peace-time, to quietly bury the Declaration of Paris in the middle of the Channel, with naval honours, the better it will be for this country in time of war. You could then arm your merchant steamers, your volunteer yachts, and so forth, and make the whole nation a naval nation, but you cannot do it while the Declaration of Paris exists as good paper. Then there is the question of masts and yards. It has been said that there used to be a fine old "pipe" when the lower yards lay across the bulwarks; one pipe to "Cross royal yard," and it was done. I venture to submit to naval Officers present whether it is not possible, even in these days, with the sailors and Officers that man our ships, to have yards and sails and keep your stations, and so save your coal, and to give another pipe when you want to chase or to take an important announcement to the Admiral or the shore, and that is, "All yards on deck," and would not they be down quite quick enough for the cruizer to steam head to wind, just as well as an Atlantic liner can? If you mix up the cruizer and the fighting ship, I think you are doing wrong. I think you must have the cruizer purely as a scout to look out, to bring in intelligence, but capable of fighting a ship of its own size, and therefore I do not think the yards and masts, if they save the coal, will be found in the way in war-time, and coal will be precious in war-time, for colliers will not be able to roam about the sea as they do now; they will be snapped up as prizes, for coal is contraband of war. There is some allusion in the paper with respect to the seamen and Officers, as to their education. It seems to me, without going into particulars thereupon, that the tendency of the Navy, to a very great extent in some quarters, is drifting towards soldiering, and it appears to me, if it is not checked by those men who have the sea at heart, we shall soon, figuratively speaking, have the blue-jackets pipe-claying their white collar bands and the Officers wearing down-peaked caps, like the Guards. I cannot say that I like that tendency. I certainly think we must acknowledge that, seeing that engines and guns have come to be worked by electricity, or other motive power, scientific training is necessary, but I do not think the time has yet come for doing away with the British blue-jacket or seaman-gunner, nor the Officer who has the heart of a seaman within his body. Admiral Wiles said that the cry was at a certain time past, "the ram, the gun, and the torpedo," and he asks, "Where is the ram? Where is the torpedo?" But I think the cry has been very much of late, "Where is the gun?" I think the only answer to that is that it is in the manufacturer's hands, and the sooner that reasonable details of business between the Admiralty, the War Office, and the producer are worked out thoroughly, so that the guns are up to time with the ships, the better it will be for the Service. Then as to education; now, for the last few years many have looked with horror upon the amount of education that an Officer of Lieutenant's

rank has to go through; and I think we shall have to stop giving any increased education till we have bred a new kind of man, with a larger displacement to his head. I think that the paper is quite correct in saying that the attention of the Officer ought to be turned rather more to the handling of his boat and ship, for it is more important that he should become a good boatman and a good handler of his ship than that he should be seen poring over a lot of logarithms and chemical analyses, because he will soon pick up anything he requires in that line when he gets put into a special department to work it. To know his ship is the first order of the day, and the man who cannot work his ship will lose his action. I now go to the question of the Naval Reserve, and I will not touch much upon that, because I see a Naval Reserve Officer on my right (Mr. Caborne). I leave the Naval Reserve confidently in his hands. But I should like to say one thing, and that is, I think the country has not awakened to the fact that the Naval Reserve might be vastly improved, vastly augmented in time of peace, and then it will not be in chaos in time of war; but if you leave it till time of war, and then have to start a kind of *quasi* press-gang to hunt up seamen, it will be too late. You will not have time to train either Officers or men; you will have a good article, but without training. The country might get off cheap enough now if they would only throw out a bait tempting enough, by increasing the ranks in the Naval Reserve, by making it possible that the Naval Reserve Officer should hold the rank of Commander. It is absurd to me to see an Officer of a fine ship, such as the "Teutonic" or "City of Paris," a man of perhaps forty-five years of age and thirty years' sea service, ranking only as Lieutenant. I think that these men ought to rank as Commanders, and when they are called out to active service there are plenty of small ships of which they could be put in command, without treading on the toes of any naval Officer on the active list. Increased rank would be a very great bait to catch the best fish. The men might also be improved in position, and if they were more brought in contact with the Navy, so as to learn the routine duties of a man-of-war, and also what are the comforts and the prospects of a man-of-war's man, I think they would then come to the Service, and we should have none of that vanishing away into thin air that is mentioned in the lecturer's paper.

Admiral Sir GEORGE TRYON, K.C.B.: I should not have ventured to have spoken to-day, at least, I thought I should not, when I heard that the lecture was to be given with reference to the Manœuvres. I have not had time to do more than glance over the paper; but when I did so I found that it was not a paper so much with reference to anything that occurred during the Manœuvres as it was in relation to the organization and to the system of the administration of the Navy as exemplified and experienced in those Manœuvres. I venture to say with reference to the Manœuvres, the question with those present was not to consider how young gentlemen were educated, or whether stokers ought to be drilled, or how men ought to be obtained, or questions as to the Reserve, but it was with us who were actively employed, how to make the best use of the materials that were placed in our hands; and I venture to say, as one of the Officers in command, and in the presence of Officers who commanded ships on that occasion, that we were very satisfied with the personnel that was placed under us. Of course we should have liked everything more perfect; we always asked for more. We know the Admiralty just lately have turned their attention to giving us a more ample supply of fit stokers. You cannot get them at a moment's notice, and there are but few available in the mercantile marine. I see gentlemen before me of authority in the mercantile marine, and I can tell you that this is not a new subject with me. There are very few Companies who retain their stokers permanently in their service, and the general complaint in the mercantile marine is what an indifferent set of men are sent on board as stokers. Of course there are some that are very good, and we should be glad to have them, but the mass are not suitable. On the whole, the stokers are a difficulty, but we are getting over that; we are training them, and we are much better off than we were last year or the year before. We have heard expressions about the gun, the ram, and the torpedo, and that the ram and torpedo are gone, and the gun alone remains. I do not concur with the observation. I know that when the Officers who were serving with me were present in my cabin consulting over matters, it was felt that as we had in some of our ships

but four heavy guns, and those four guns were necessarily very exposed, it was quite possible that at any moment one, two, or perhaps more might be disabled. But it was not the intention of one of those Officers to fall out of line because a gun was disabled, but rather to concentrate his attention on the use of the ram, and it was felt that the Officer who concentrated his attention on the use of the ram was more likely to be successful with it than the one who intended to use gun, ram, or torpedo, whichever might by some chance be afforded an opportunity. With reference to torpedoes, I think they are necessary, if only for the reason that they are the best antidote I know for the ram. I therefore think the gun, the ram, and the torpedo all have their respective duties. I should not have ventured to say a word to-day if I had not known that the discussion had taken rather the form of re-editing the paper, able as it is; it touches on so many subjects, and opens such a wide field for discussion, that it is difficult to deal with it. There is only one point that touches myself and the duties I have to perform, and that is with reference to the result of calling out the Naval Reserve. It is stated as a literal fact that at the last war-scare the men in training on the north-east coast disappeared. I think that is an anecdote; we hear such stories told by almost anybody about everything. Admiral Mayne also says he thinks we ought to do away with the Second Class Reserve and take more of the First. As a matter of fact, it would be very difficult to largely add to our number of First Reserve men. The number of Second Class Reserve men could be increased if it were required. But I may mention this with regard to the want of confidence apparently entertained by Admiral Mayne in the Second Class Reserve, and that is expressed in the paper—I think that those Officers who have most studied the question or had experience of it will differ with him. I have not seen a single bad report with reference to the Second Class Reserve. On the contrary, His Royal Highness the Duke of Edinburgh spoke most confidently of them. My predecessor, Admiral Baird, spoke most confidently of them, and I think we may be confident that if this country requires their services they will come forward quite as cheerfully and readily as the Volunteers will to back the Army. Allusion has been made with reference to Officers in the Royal Naval Reserve. I am happy to say comparatively recently a modification of the Regulations has been made by their Lordships which has succeeded in bringing the Service more within their reach. No less than fifty-one young Officers joined us in the last half-year. It was a great consideration to get young Officers, and also young Officers who would go to sea, serving for a year with us, and I know not one who has not brought back with him a good report of his new life and messmates, and of the treatment he has received. There is one question I think Mr. Baden-Powell spoke of, a question of rank and baits. Now I think no baits are required. That which is offered is very substantial. We have numbers of men offering for the Second Class Reserve. If we have not so many for the First, it is because we really practically have most of the really available men in the mercantile marine. As regards Officers, we have had many applications to join the Royal Naval Reserve. There is the question of rank, to which he has referred, and a very important one it is. The great standpoint in the Navy is that of Lieutenant. Once a Lieutenant, you may jump rapidly to almost any rank, and if war arises it is impossible to foresee how rapidly Officers may rise to higher rank, as was the case in days gone by. We may take the experience of the American Navy in their great war. The highest rank they gave was that of Acting Volunteer Lieutenant Commander. At the end of the war the Volunteer Officers were scratched off the list; there was only one seagoing command of importance given to these Officers, and that was given to an Officer who commanded the "Vanderbilt." There were many Acting Volunteer Lieutenants given gun vessels and smaller vessels. Should the Naval Reserve Officers ever be called out on service, they will be welcomed by their brother Officers, and it will be to "a fair field and no favour," and the best men will go to the top of the tree.

Captain T. S. JACKSON, R.N. : It has been said this afternoon that the conflict of opinion of naval Officers is a source of difficulty to the Admiralty. If that is the case, how very easy the Admiralty must find it to carry out any reform on which we are practically unanimous. A paper like this, at all events, brings out the points

on which we differ. We are not always equally emphatic on points on which we are all absolutely agreed. That speed in ships and also coal endurance are necessary, are points on which there is no difference of opinion. I leave all those out, and will go to those points on which I differ, whether much or slightly, from Admiral Mayne. The Naval Manœuvres, he said, proved the deficiency of Officers of Lieutenants' rank. So far as my own experience went I do not know that they did. The ships were sufficiently manned; they were well manned; they were also well officered, as far as I had any opportunity of judging. Of course a larger supply of Lieutenants would be required in event of war, and provision ought to be made for them, but I quite agree that the Lieutenants' list ought not to be increased from the ranks of Sub-Lieutenants. I submit that there are other ways of increasing it. There are many Warrant Officers of high education who have passed in navigation. Sir George Willes is mistaken in thinking that we began to teach the Warrant Officers navigation only two or three years ago. In the "Cambridge" twenty years ago the whole of the Warrant Officers were instructed in navigation, and I submit that Officers can be promoted from the warrant rank. They would be of such an age that, except in war-time, they would probably have no great opportunity of rising higher than Lieutenant, or at all events higher than the rank of Commander. They would be very well satisfied with the position that they reached, and the extra retirement to which they became entitled on reaching the rank of Lieutenant. You would then have a body of Officers perfectly capable of doing the ordinary work of Lieutenants, who would not be always thinking they were ill-used if they were not promoted to the rank of Commander in the next batch. Then, as to the deficiency of stokers. Was there any deficiency of stokers? I have not the slightest idea that there was. As far as the ship I commanded was concerned the complement of stokers was complete. There was a large proportion of 2nd class stokers who were very green, but they worked well; they never fell out from their work, and they improved as matters went on. Of course there are many points connected with the Naval Manœuvres which appear absurd. Many events occurred which would be impossible in real war. Mr. Baden-Powell is quite right about the reported capture of fast merchant ships, but he must recollect that these Manœuvres were simply a game played according to certain rules, and the rules gave Officers an opportunity of effecting a capture by sticking close to a merchant ship which could have left him easily if she had chosen. In the same way must be regarded the rush made on all occasions, both last year and the year before, to get to the Thames. What on earth would a squadron like that commanded by Admiral D'Arcy Irvine do if it got to the Thames? They could do nothing whatever, except wait and blockade the place, until they were picked up by an English squadron and destroyed. The question of fortifications was utterly ignored, whereas the existing fortifications are far in excess of what is really wanted to keep off a fleet. Those fortifications were absolutely ignored by the rules. We find gunboats and torpedo-boats going up the Liffey, past Pigeon-House Fort and destroying in broad daylight the ships at Dublin. I should like to see any torpedo-boat go past Pigeon-House Fort in war-time. Certainly Admiral Mayne has pointed out one blot in the matériel with which we are provided for naval war, and that is that we have no ships at all capable of delivering high-angle fire. We have never yet got through any naval war without attacking fortifications in some way or other, and we have never been successful, except against a vastly inferior enemy, unless we had high-angle fire. We find at the end of the Russian war we had mortar-boats by the dozen. In the operations in the Mississippi, Admiral Porter's mortar-boats enabled Admiral Farragut's fleet to pass the forts below New Orleans with a very small loss, owing to their having bombarded them for several days beforehand. We have never succeeded in carrying out any naval attack of great importance without mortar-boats. Well, now we have absolutely nothing, we have not even the preparation for anything of the kind. We have not decided what the style of rifled howitzer or mortar is to be which will be mounted on the ship, and when we arrive at the piece of ordnance I do not believe we have got a mounting for it. Admiral Mayne proposed something of the "Handy" class. If you have ever been on board the "Handy" when the gun was fired you will know it was very difficult to stand up, and you do want for the moment of firing—for high-angle firing—an absolutely steady platform. I fancy

it would be difficult to get accuracy from any craft of that kind. But that is a mere matter of detail, and I am very glad the question of high-angle firing has been alluded to, and that I can so cordially agree with Admiral Mayne on the subject. It is quite impossible to touch on all the points or half the points that the lecturer has alluded to, but there is one that struck me—perhaps it did not strike the lecturer so much in the Manœuvres as he was, I think, tied to a battle-ship—and that was the extreme value and importance of cruisers, and the infinitely greater importance of their work than that of ordinary battle-ships. We find that Officers of experience and of great reputation were put in command of the heavier vessels and really had practically little to do. The position of an Officer in command of a cruiser was one of very much harder work and much more importance. That would point to the selection of Officers for the command of cruisers being a much more important matter than that for the command of battle-ships. Another point which struck me with regard to cruisers, which I had no idea of before, was the enormous duration of the chases that we might expect in war. Four¹ of our cruisers chased on one occasion two of the enemy's cruisers for 200 miles, until nearly all of us broke down. That is something quite beyond anything I had previously expected for a chase. That, I think, shows more than ever that we must be absolutely prepared to steam long distances and we must be prepared to keep up the speed; we must not be satisfied with short runs, and it is as important for a man-of-war cruiser to be able to keep up her speed at sea as it is for any merchant vessel; it must not be considered a matter of short runs.

Lieutenant W. F. CABORNE, R.N.R.: As an Officer of the Royal Naval Reserve, I should like to say a few words on this occasion. I may mention, however, that Admiral Sir George Tryon has rather taken the wind out of my sails by some of his remarks, not that I complain of that, because I was very pleased indeed to hear his statements. With regard to the anecdote about the Second Class Naval Reserve and the so-called war-scare, it is very unkind on my part to try and spoil it, but I am assured by a naval Officer who commanded a drill-ship on the north-east coast at that time, that to the best of his recollection and to the best of his belief, there is not the slightest foundation for the statement put forward. Coming to the present strength of the Royal Naval Reserve, Admiral Mayne tells us that there are 264 Officers and 18,000 men, but, as a matter of fact, on the 31st of January, 1890, there were on the Active List (including Lieutenants, Sub-Lieutenants, Midshipmen, Engineers, and Assistant Engineers) 545 Officers—or rather more than double the number named—and enrolled in the various classes 19,369 men. I will now pass on to another paragraph of the paper. The lecturer, speaking of Lieutenant Colwell's report, says, "And he goes on to give it as his opinion that it would be a liberal estimate if one-third could present themselves at the rendezvous in a fortnight"—*very liberal*, I think—and "those might find themselves drafted to a class of vessel with which they were totally unfamiliar, and stationed at a type of gun they had never seen." Taken in conjunction with that which has gone before, this abridged quotation would seem to imply that not more than one-third of the men would turn up owing to their unwillingness to serve, but that was not what Lieutenant Colwell meant, as he distinctly states the reason to be that they are scattered not only all over the United Kingdom, but also in different parts of the world. Now, I think I effectually disposed of that argument last year, when I had the honour of reading a paper on "The Royal Naval Reserve" in this theatre. I then pointed out that at that time less than one-quarter of the number of men enrolled were absent from the United Kingdom, and that the majority of those so absent would be available for service on foreign stations. At the end of January, out of the 19,369 men enrolled no less than 15,767 were at home, in the coasting trade, and making short voyages to near Continental ports, all of whom would be available for service in a week or ten days. With regard to the men being drilled with obsolete weapons on board obsolete ships, no doubt that

¹ The "Aurora," "Galatea," and "Forth," afterwards joined by "Warspite," chased the "Mersey" and "Arethusa" for fourteen hours. The distance covered was about 215 miles.

is a fact. But whose fault is it? Is it the men's? I have stated before in this theatre, and I fearlessly and unhesitatingly repeat the statement, that the Royal Naval Reserve will be found ready and willing to do its duty when called upon. I need not enter into the "Trent" affair, as that subject has already been mentioned. I have yet to learn that merchant seamen are cowards, and would be unwilling to assist in the noblest and highest of all duties—the defence of their country. I venture to think that in all the great wars of the past merchant seamen bore a not undistinguished part, and I claim that the history of the Royal Navy is also, more or less, the history of the mercantile marine. I will only give two instances of the services of our merchant seamen, and then I shall have finished. Admiral Sir George Byam Martin, in his evidence given before a Select Committee of the House of Lords, in 1848, said that all who were acquainted with the state of the Navy, prior to the outbreak of the war in 1793, were aware that Lord Howe's glorious victory of the 1st of June, 1794, was won by the merchant seamen of the Kingdom. Again, in the Museum of this Institution there is a sword of honour, which was presented to the Captain of one of the Honourable East India Company's ships as a memento of a certain day in April, 1804, when a fleet of British merchant ships engaged, beat off, and chased a squadron of French men-of-war. Why should it be said that the successors of those men have degenerated? In conclusion, I would say that we do not object to criticism—in fact, we court it—but we ask, and we think we have a right to demand, that such criticism shall be at once fair, intelligent, and based upon facts.¹

Rear-Admiral BRINE: I think, Sir, in the first place, I may say how much we in this theatre are indebted for the very able lecture that Admiral Mayne has given us. It has gone over a great many points, and I may say, in my opinion, he has touched upon all of them with a great deal of light, and a great deal of justice. I rise on this occasion particularly to call attention to his views, partly his own, partly quoted, with regard to the Naval Reserve. It is a point, perhaps, upon which I am, to a certain extent, qualified to speak, because for a good many years of my professional career I was mixed up with the men, both with the First Class Reserve and the Second Class Reserve. I was at their drills and at their homes; in the drill-ships and the drill-sheds, and became very intimately acquainted with the value and the work of these men. With regard to the point which Admiral Mayne first of all discusses, which is as to whether the men will or will not be available in time of war, it is hardly worth while, I think, saying very much about that; those who know the subject know that the men are available, they know that the men will come forward, not merely by the force of public opinion in their villages, but because the men, as a body, are very trustworthy, very honest, very straightforward, and to use their own expression, I should think they would never go back from their word. They have given us their word, and they will keep to it. I now pass to a thing of much greater importance. When an Officer of cool judgment and intelligence comes to this country with distinct instructions to report to his own country upon our position as regards our Naval Reserves, and that report is put here before us, it becomes a positive duty that it should either be accepted or denied. I read it because it is a very important report. He says, and this is the statement of Lieutenant Colwell speaking of our Naval Reserve, "The material of which it is composed is admirable"—that is very satisfactory—"but the system is open to the objections that these men, if drafted on board a modern man-of-war, would be nearly as useless as any other untrained men their training would be found to be of little value, for they have no permanent organization, no permanent Officers whom they know and to whom they are accustomed, no uniform system of instruction has been given them, and the weapons with which they have been in the habit of going through their annual

¹ The lecturer is in error in stating that the Second Class Naval Reserve men get 6*l.* bounty, and are kept for six weeks. In reality, they receive an annual retainer of 2*l.* 10*s.*, and are required to drill for four weeks; their total remuneration for the year, including retainer, drill pay, clothing, and lodging allowance, amounting to about 7*l.* 12*s.*

drill are obsolete, and no longer find a place on war-ships." This statement has to be faced, and I need not say it is a very difficult subject. Nothing is more difficult than to know how to deal with these men at their drills so as to bring them up to modern requirements. Everybody who has anything to do with these men knows that much of their life is given up to occupations which in time of war will prove absolutely useless for the object for which we require them. We must look back to thirty years ago when this force was established. The chief consideration at that time was that the First and Second Class Reserve men should be sailors, men qualified to go to sea, to go on board ship and take part in what was going on, and at that time they were fitted for their work. If those men had then been told to go on board the "Victory," and fight the Battle of Trafalgar, they would have done their duty thoroughly, they would have fought that battle as they did before, and they would have won it again. But if you tell these men to go on board our latest ironclad, the "Victoria," and fight the French ironclad battle-ship "Redoutable," I think they would feel themselves placed under conditions very strange and new; they would not understand the heavy guns, they would not know anything of the quick-firing guns, they would know nothing practically of what was around them, and they would be very much handicapped when they came to fight. That is the case. What can we do? I venture to give the opinion, but it is only an opinion, that some plan will have sooner or later to be adopted, by which a very much superior system of supervision and inspection as regards the gunnery drills and of cohesion in the general training of the men will have to be brought about. An Officer will have to be appointed who will be personally responsible for the drills, and for the efficiency of these men. He must be an Officer who thoroughly understands the special work that he has to do; he must know how to bring these merchant seamen and fishermen together as a disciplined force, he must understand the character and capacity of the men, and he ought also, of course, to understand what kind of training these men require. I venture to think that this Officer must be an Officer of high rank. He will have to deal very much with the Registrar-General of Seamen with regard to the First Class Reserve, and with the Board of Trade with regard to the Second Class Reserve, and, of course, with headquarters with regard to whatever plans it is wished to carry out. I think, if that Officer is properly supported in his duties, that within a certain number of years, perhaps five—for it would take five years to bring these men into practically efficient training—we should be able to say that we have a body of men absolutely fit to take their place on board of our ships, and to fill up the waste of the seamen of the Navy in time of war. At present, there is a doubt whether they could do that, but much can be done, and I am convinced when that is done, we shall feel very much more safe as regards our permanent position as a great Naval Power. We shall be of greater strength, and we shall also feel that as war goes on we are secure when sending drafts of men from this country to the ships, especially to the cruisers, that they will really be fit for the work they are called upon to do.

Mr. REGINALD OLDKNOW, Fleet Engineer, R.N. (retired): I only think of saying a few words, because it seems to me that the lessons of the Naval Manœuvres, to which I shall strictly confine myself, have not yet been touched upon, excepting in a very perfunctory manner, from an engineering point of view. One of the very first lessons, in fact the first and most important lesson to be derived is the fact, and the warning too, that our cruisers were never able to approach within three knots of their estimated speed. That is due to various causes—to that which has already been dealt with by Admiral Mayne, that they are too short for sea-work, that any sea-way inevitably checks their speed, so that their chasing power is wasted in churning water. It is due still more to the fact that they do not really have the nominal power put into them. You might just as well chuck the money into the Thames which is expended in the horse power necessary to produce the speed on the measured mile of 19 knots, when all you can get in actual service is 15 knots, because that is what it comes to. The "Warspite" we hear a good deal about—she is supposed to have done very well, seeing that she chased for fourteen hours with an average speed of exactly 15 knots. That is nothing to brag about. But worse than that, we learn only this morning that she left Chatham for the Manœuvres 30 per cent. short of her proper

complement of stokers, and that those were supplied by needy lads, second class men who are no use; so that when she arrived at Chatham after the short campaigning, her condition was simply terrible—the pistons were grown together, the slide gear could not be moved by hand, and she was altogether to pieces, because she only had a small proportion of men actually acquainted with the working of the engines. So much for the "Warspite." Another thing made manifest was that something will have to be done to prevent the emission of smoke, as no naval action would be possible under certain circumstances on account of the smoke, although it is stated in the official "Narrative" that the very best Welsh coal was used. Not only could no action have been fought on account of the smoke, but also no ship could possibly have been sent upon any secret mission, if at a distance of 15 miles she was visible to anyone wanting to see her. As to forced draught, I think we may take it for granted that invention of the Evil One, as Admiral Mayne called it, is doomed, excepting for torpedo-boats. Nine-tenths of the breakdowns that occurred, owing to the giving out of tubes, and the destruction of fire bars, were due to an improper and excessive use of that forced draught, which I hope to learn one of these days has been entirely abolished, and done away with altogether. But the main reason why the cruisers are so utterly ineffective is the merciless cutting down of weights by the Constructor's Department at the Admiralty. If room is wanted, cut it out of the machinery. For increased coal endurance, even, engine room is sacrificed to bunker room, never mind that as long as you squeeze your machinery into a next to impossible space. The system of cutting down weights has become so terrible that contractors are literally frightened at the very smallest proposal to add the most necessary thing—a little bit of piping, for instance—because they are afraid it would add to the total weight. The manager of one of our very highest marine engineering firms told me the other day he was overwhelmed with joy because the engineer in a ship of the "Rattlesnake" type agreed to do away with a spare spanner, weighing 7 lbs.¹

Admiral COLOMB: I have to begin by disagreeing a little with my friend Admiral Boys, as to retired Officers speaking; although they are old and feeble, their tongues are a little freer to speak, and I think if they endeavour to collect the real opinions of the active Officers and put them forward in a discussion of this kind they do their duty, and a certain amount of good. The Admiralty has been touched upon in the paper, although the passage relating to it was not read; but it has been discussed, and I think one might say in a general way that the work, good or bad, of the Admiralty is not absolute but relative, and I want to know whether there is any department in the English Government which, take it all in all, does its work better than the Admiralty? If I might say so without offence to the gallant lecturer, I would remark that he has brought together in a general way the pious opinions of the Navy, with the object of getting out any further pious opinions that may lurk in the breasts of the hearers of this paper. We'll have our pious opinions about the Admiralty, all of us, and we think, I believe without a dissentient voice, that it was a pity that the Orders in Council of 1869 were ever put forward. We think that it is a pity that the statesman whom we all admit must be at the head of the Admiralty should not be obliged to hear all that his councillors have to say. I do not think any of us ask for any more, but I do not think that we ask for very much less. I think that a civilian statesman at the head of a highly technical service like our own is in a very bad position if he is able to hear the opinions of some of his council and not of all. Reference has been made to the competition for entrance into the Navy, which seems to come next on the list. I do not think it matters whether you have the present system or whether you throw it open to public competition, but I do think the check the First Lord of the Admiralty has with regard to people who, from their outside standing and so on, would not be desirable in the Navy, should be maintained. I have every

¹ Although many of the details discussed and lessons deduced are of very great gravity and importance, they are insignificant beside the one grand lesson of all,—that our Navy is not strong enough, nor nearly strong enough, for the work it would be called upon to do in time of war.

reason: to believe that there is no difficulty on the part of any parent getting a nomination for a naval cadetship for his son, if suitable, and I do not think he would be any better off if it were thrown open to public competition. We next come to the question which the lecturer dwelt upon, of everybody in the ship being a combatant. That is a pious opinion that I have never heard controverted by any naval Officer that I have met. I believe we all wish for that ideal to come when every soul on board Her Majesty's ships should be a combatant person, and when we should get rid of different classes, and have only one class of combatant persons for all purposes. Whether we are ever going to get it I do not quite know; but I believe that, speaking still of our pious opinion, we can agree with the lecturer that a great deal may be done if we keep that principle continually in mind. With regard to the stokers, I had the satisfaction on one occasion of receiving from my Commander-in-Chief a sort of reprimand from the Admiralty for a certain expenditure for ammunition that I had authorized in order to make the stokers marksmen. Well, I was very glad to take the reprimand, because the stokers fairly understood how to handle the rifle, and I was quite ready to take another reprimand of the same kind. Speaking of the Naval Reserve, I cannot help regretting that the lecturer has put forward that anecdote of the Naval Reserve on the north-east coast. But I think that really he did it with a certain purpose, and that was to bring up on the other side what was to be said. We have had from the other side over and over again, that after all, the Naval Reserve are Englishmen, and feel like all Englishmen, and when the time comes they will go to the front. As to the education of naval Officers, I have two sons in the Navy. The lecturer has stated in one part of his lecture that one thing which the Naval Manœuvres brought forward was the excellence of the personnel, and he dwelt particularly on the excellence of the junior Officers. Well, now you see we must put two things together. The pious opinion is that the present system is not a good one, that is to say, in our zeal for reform every naval Officer would like to see things better than they are: but at the same time we must bear in mind that the young Officers of the present day are infinitely better than they were in most of our younger days. We who can look back to times long past know very well what the change has been. And although I think that the movement of the Admiralty in increasing the age of entry for cadets was a good one, I think any movement you make in this direction must be exceedingly tentative and careful, that you had better not interfere too much with what is working, as far as the practice goes, as far as the eating of the pudding goes, exceedingly well. We now come to cruisers and chasing. We all are agreed, every one of us, that if you want speed you must have length, and it was pointed out by Admiral Seymour, and was referred to in the reading of the paper, that length did not so much interfere with manœuvring power as people believed. Length is but one out of about a dozen elements which make manœuvring power; and some of your largest ships are your best manœuvrers; the "Minotaur" and the "Northumberland," two of your longest ships, are also two of the very best manœuvrers you have in the Navy. Mention was made of the "Anson," as being a bad manœvrer. I cannot speak for the "Anson," but I can speak distinctly for the "Edinburgh," which had the same lines, or nearly so, as the "Anson." There is no shadow of question that the "Edinburgh," which is 75 feet shorter than the "Minotaur," takes a full ship's length more space in manœuvring than the "Minotaur" does. As to getting speed and chasing, of course if you have the speed your chase will be shorter, but I do not quite think the lesson of the manœuvres in chasing merchant ships is entirely to the point, because it is no mere chasing that you have to deal with. If you are bringing the fire of two or three 6-pounder quick-firing guns to bear on the chase, and bursting shells continually about her ears, I think most merchant captains would find that it was their duty to expose life for the mere guarantee of property, and therefore I think in actual war for that reason the chases would be somewhat shorter than they proved to be in the Naval Manœuvres, when there were no shells flying about. I am glad to see the lecturer dwelt upon a question of importance, namely, the signals of ships, and signals round the coast. It was a great element in the preservation of our commerce in the old wars, and although the signals of those days were exceedingly elementary, they did their work. In these days where the signals have improved

to a very great extent, I conceive that you cannot have anything more preservative of your commerce, and of your shores generally, than a first rate system of signal stations connected by the telegraph, with headquarters round the coast. But you must recollect that we in the Navy are only now beginning to think that the question of signals is of importance. This discussion brings back to my mind the days when I thought that they were very important, some twenty-five years ago, and when I was looked upon for quite seven years, by the Admiralty of those days, as a public enemy, because I did think so, and because I pressed the question forward. In the Army all these questions are dealt with in a totally different way, that has been mentioned. The Army do take methods when any important matter comes up; they do put it in practice; they have a larger staff, with great expense about it to carry it through and put it right. For instance, we had the range-finding the other day; the position-finding for our fortifications; we had the arranger of that system paid 25,000*l.* and 1,000*l.* a year for ten years, and we have since had appointed an Inspector of range-finding, and no doubt he will have a staff, and you will have very expensive arrangements for that. Now, I think the Army in their way go as much to the extreme as we fall short of it. I think there is a medium, but in the Navy we do not reach it; we do not go so far as we ought to go, although I should be very sorry to see us go as far as the Army does in these matters. As to the question of signals, I think it is time that some Officer should be appointed specially to look after that service. I think it never will come right, and I do not think you will get the best that can be done, until that measure is taken. Masts and sails, we were told by the gallant Chairman, were gone, and I can only say I am exceedingly glad. But I have observed in the discussion one important mistake which has been made by the supporters of masts and sails, they have always gone upon the theory that masts and sails are an economy in the way of coal. Now, I had the honour of reading a lecture here on the question, and greatly to my astonishment, on going very carefully into the figures, I found that so far from masts and sails ever being an economy when put in a man-of-war, they were always a dead loss; they always cost the coal to carry them about. [Admiral Sir HOUSTON STEWART: Oh! oh!] My gallant friend says Oh! oh! but that is so, and you cannot get over it.

Admiral Sir HOUSTON STEWART: I remember you sent that paper to me at the Admiralty, but your brother Officer, in a sister ship, entirely differed from you. The conclusions of the Captain of the "Iron Duke" were totally different from yours. They were both laid before the Admiralty.

Admiral COLOMB: I have yet to learn whether the Officer who differed from me had done what I did, and got at the figures. I never heard of anyone but myself doing it. With regard to retirement and promotion, which has also been spoken of, I think the point and the difficulty in that question is that you have been applying your retirement both in the Army and the Navy in the wrong place. You want to bring your retirement to bear where the shoe pinches. Now, the shoe pinches in the Navy amongst the senior Lieutenants, and in the Army amongst the senior Captains, because that is the place where the large numbers have to be squeezed into small numbers, and I quite think that if you would apply a large liberal retirement there, where the shoe pinches, you would find it was not nearly so necessary to apply it higher up. You would save a great deal of money, and give a great deal of contentment by doing it. With regard to gunnery instruction, although my excellent friend Admiral Boys differs from the lecturer, I understand the opinion, which is now almost universal in the Navy, is that the time has quite come when every blue-jacket ought to be a gunner, and that the higher class of instruction should be kept apart for special men, captains of guns, instructors, and so on. A question has been raised as to the time of the men being wasted over instruction in harbour. Well, now, I do not say that, because I understand the modern policy to be the preparation of numbers of men corresponding to the ships that you have in reserve, to provide men ready to man the ships that are ready for them, and it seems to me from that fact that we must accept the position of having large numbers of men in harbour. I think every man ought to be a seaman-gunner, that is to say, I think that every man should pass through the "Excellent." That is what it comes to, the real people who stay in harbour, but have no busi-

ness there, if I may say so, are, in my experience, the second class men, the bad hats; those are the people that are so difficult to send to sea.

The CHAIRMAN (Admiral Sir Vesey Hamilton): Before I call upon the lecturer to reply, as I have a few remarks to make rather against his lecture, I will make them now instead of afterwards, in order that he may have the opportunity of replying to them. When I introduced him on Friday last I observed that the rule of this Institution was that the Chairman was not responsible for the lecture in any way, and in this case I certainly was not, for I had not read it till I came here. Had I done so beforehand, my opinion is I should have advised the lecturer to have condensed it into two columns, by saying what he approves of. He has given us twelve columns of what he disapproves of; in fact, I rather look upon it as a sweeping condemnation of everything connected with the Navy except the personnel. The administration is wrong, the education in "Britannia" is wrong, and the training of Officers after leaving is wrong, the ships, the boilers, everything is wrong; in fact, the only lesson to be derived from the Manœuvres, as far as I can make out, is that everything is wrong. Under these circumstances it is my opinion that the gallant lecturer ought to get up in his place in the House of Commons and propose to abolish the Navy bag and baggage. The lecturer is strongly of opinion, in which he is supported by Admiral Colomb, that our Lieutenants should be Admirable Crichtons, able to do everybody's duty. It seems to be supposed that our Lieutenants commanding torpedo-boats and manœuvring them at 20 miles an hour, after having imbibed an enormous amount of oxygen in that way, should then be put down into the Paymaster's office in order to get rid of it. I heard it remarked, after the first day's discussion, "Would the gallant lecturer like to have his leg taken off by the Lieutenant-Surgeon or Surgeon-Lieutenant?" I do not believe in Utopias or in Admirable Crichtons. I am rather of opinion that most of us should stick to his last. The lecturer has summoned to his aid, with regard to naval education, the opinions of a German. I think the opinions of that German Officer are of as much value, with regard to what he knows nothing about, namely, about our naval wants and duties, and details of our system, as my opinions would be if I were to attempt to criticize the details of the German Army, of which I know nothing. Therefore I attach not the slightest value to any foreign opinion on this point. The proof of the pudding is in the eating. Except France, whose Navy, like our own, is a very old Navy, every nation comes to us for information on naval matters, and some ask for our Officers to train them or to let their Officers join us. The gallant lecturer does not say anything about the way in which the Manœuvres were performed, whether the seamanship was good, whether the plan of campaign was good—he does not give us any credit on that point, or any opinion. Another point I wish to remark upon is where, quoting Lieutenant Colwell, he points out that the Germans have transferred their coast defences from the Army to the Navy, and you will see by Table III. that though we have almost as many ironclads as any three nations, we are far inferior in our proportion of coast-defence ships. The lecturer here, I do not think has gone deep enough into this question. The reason is obvious. Both France and Germany, in the event of war, want every available soldier on their frontier or beyond it, and their navies are of secondary importance. It is on land that the fate of Continental nations will be decided, while with us, our decisive battles must be fought on the sea. Our frontier, as Nelson pointed out, is the enemy's coast, and it is there our Navy should be; and as the great Duke of Wellington said, the influence of the British Empire would be very limited if the naval force was required to guard and defend the coast. Coast-defence, in reality, is the resource of a weaker naval Power to try and balance its inferiority by immovable forts. I will not detain you longer at this late hour, except to point out two errors in the lecture, first with regard to the 9.2 gun being sufficient for almost every purpose of penetration. The lecturer says that it will penetrate 27 inches. As a matter of fact, it will penetrate 14 inches of backed armour under the most favourable circumstances, *i.e.*, at right angles. Another point on which he has spoken has been the insufficiency of stokers during the Manœuvres. Now, the total complement of the Fleet for the Manœuvres, of engine-room Officers, was 218, and they were none short; the total complement of artificers was 687, and they were five short; the total complement of stokers of all ratings was 3,927, and they

were fourteen short; in all, out of 4,832, there were 19 short; and at that time there were in the various home ports, 119 engineer Officers, 101 artificers, and 595 stokers, so that it was the fault of the Captains who commanded these ships if they were short, and on my asking the Captain of the Steam Reserve at Portsmouth if the ships were fully manned with stokers, he answered, "I have supplied every requisition, and I have stokers in reserve, and there has nobody come to me." A little fact like that is much more conclusive than any amount of theory.

Admiral MAYNE, in reply: I may say, in the first place, in thanking you for coming, and my brother Officers for criticizing this paper in the way that they have, I am extremely pleased and gratified at the reception that has been given to the paper, because to a certain extent it has done exactly what I wanted. I said in the paper that I wanted the opinions of those who were much better able to express them than I was myself. I only regret that the Chairman has not been able to give us his views at greater length, and that I have no time for detailed replies to the various criticisms made. As to the remarks made by Sir George Tryon and by the Chairman, with reference to the Manœuvres, I have given in a table the ships that were out, and the general results, but I suppose you did not expect me to come here and criticize the strategy of Admiral Tryon, Admiral Baird, and other Admirals, because that is the very last thing I had in my head to do. With reference to the Chairman's last remarks, as to my having stated that the penetrating power of the gun was three times its calibre, it is a misprint for "twice," and I should like to say here that the paper in your hands is an uncorrected proof, in which, no doubt, there are many errors. But, with reference to his figures, with great deference to him, I prefer my own, and mine are that the penetrating power of the 9.2 gun is 17.5 inches, wrought iron, at 1,000 yards. As to the shortness of stokers, I will only say that we have heard it, and seen it in all the newspapers complained of constantly that the stokers were short, and the stokers were inefficient. I will mention one fact—I do not know whether the Chairman knows it—that there were stokers afloat during these Manœuvres who were in receipt, and are in receipt of Greenwich Hospital pensions for being unable to perform their duties properly, who have been deserving, and are still considered as deserving, of these pensions. I wonder, if the stokers are so fit and so numerous, how it is that we are now entering them in such very large numbers. Perhaps that subject rather trenches upon the question of administration. I thought that it was an acknowledged fact that the Lieutenants and the stokers were the parts of the ships, so to speak, that were shown to be deficient in numbers, though not in ability. I have to thank everybody for the remarks which they have made, and the kind way in which they have made them, with one exception, which I think must have been through an error on the part of Mr. Caborne. I never meant in the least to attack the whole of the Reserves, or, as he made it appear, the courage of Englishmen generally, and when my friend Captain Bridge the other day spoke of the "Trent" affair, which was certainly rather ancient history, I felt very much inclined to remind him that there were no Second Class Reserves in those days; the Order in Council had only just come out, and the Second Class Reserve had not been formed. But as to one important fact, the truth of which he has called in question, I repeat that my fact is a fact, and that I asked the Officer, to whom I referred only the other day, to repeat to me the exact statement that he had made, in order that I might make no mistake.

Admiral Sir GEORGE WILLES: Was he a naval Officer?

Admiral MAYNE: The Officer in command of the District; there was no question about it. I will not give the Officer's name, but I must say I have said nothing so severe as what Mr. Caborne said only last month: "I am not very sanguine as to the success of such a plan, for I am aware that the patriotism of many men does not extend beyond what they at the moment consider to be the best interests of their individual pockets." That was a remark made in this room.

Mr. CABORNE: That was not referring to the Naval Reserve. It was taken in conjunction with shipowners employing foreign seamen in preference to their own countrymen.

Admiral MAYNE: "With reference to the presence in our mercantile marine of a large number of foreigners." I do not wish to enter too closely into it, but the men of whom I speak are supposed to be in many cases foreigners, and they are trading from our northern ports to German and other foreign ports, but it is a matter of opinion, and I adhere to mine, confirmed by Lieutenant Colwell, U.S.N., that they would not be all forthcoming when they are wanted. As to the paper generally and its title, as the Chairman has said, it is too comprehensive. The paper grew under my hands, and my only excuse is I have never read a paper here before. It is the first time I have ever appeared in public before my brother Officers, and I dictated it as quickly as I could, one thing after the other. As I say, it grew to such dimensions that I felt very much inclined to throw the whole thing into the fire; in fact it was only at the urgent request of several friends that I have appeared before you. If I have touched upon any subject that I ought not to have done here, I greatly regret it, and as to cutting out the part with reference to the administration, I am entirely in the hands of the Council. But I should like to say on that point I do not in the least agree with the remarks that the Chairman and one or two other speakers made with regard to commenting on the administration, because comment you must have, and you will have. The House of Commons, goodness knows, has enough of it, and friendly comment—comment with a view of eliciting opinions upon a system, not of condemning those who are administering it, because I should not have asked the First Sea Lord to come here to take the chair if I had meant to reflect upon his ability or administrative power, or that of his colleagues. It has nothing to do with the administrative power of the individual. The simple question, and one upon which we may gain great benefit by the discussion of naval Officers, is whether our systems, not our people, are the best. I wish I had time to make a proper reply to the questions contained in the most flattering speech of my friend Sir Houston Stewart, but I must say I think the discipline of the Navy is better now than it has been ever since I was in it. When I first went to sea under a certain celebrated man named Jack Shepherd, for three years, the discipline was of a very different character, and to say that it was any better or one tithe as good as it is now would be to make a perversion of fact. With regard to the education, I think there is a good deal of misapprehension as to the bearing of my remarks. I do not say for a moment that the "Britannia" is not a good school, in fact my complaint, as one gentleman put it, is that it is too good. All I say is, as a matter of fact, I believe the country will not go on paying for it. I say this, because in the House of Commons we hear about these things a good deal. I hear of these various things discussed, and I feel pretty certain that it is thought there is no justification—I have already been asked whether I see any justification—why one of my sons at Eton should pay so much, and the other on the "Britannia" should pay a fourth of that sum for an equally good education. Then I go further, and I say that I want to go back to the old plan which obtained when we were youngsters, and when we came in from every sort of school with every variety of ideas; and I would like people to pass what I call a competitive examination, by which I merely mean a sort of intelligence examination; take the boys straight to sea at sixteen, and then bring them back, and put them into college when they are of the same age as their fellows go to college, after two or three years at sea. By sixteen they would have got the groundwork of their education, and I take a view which may be erroneous, but which I hold very strongly, that few of us learn much worth remembering during life that we did not learn after we were grown up. I am a great believer in adult education. Ground a boy, teach him to learn, but it matters little what you put him at; the thing is when he grows up to nineteen or twenty, then he may begin, when he realizes the value of knowledge, to learn something which it is worth carrying into and through life. As to Sir Vesey Hamilton's remarks about the Admiralty, the general administration, and the whole paper being fault-finding, I confess that that was partly my intention, partly and principally, because I do not agree with nine-tenths of the present system in most of our affairs, and partly also because I was in hopes that some Officer, for instance, with regard to education, Admiral Bowden-Smith, who has commanded the "Britannia," and other who have special knowledge, would support or oppose

those parts in which they take a special interest. As to the Admiralty, I should be very sorry to abolish it without putting something else in its place. What I proposed to do is exactly what Sir George Willes urged, viz., to give actual responsibility for the Fleet to the naval Officers, and there again partly for a House of Commons reason. The House of Commons, I know—many Radicals have told me so—is now under the impression that when the First Lord comes and makes a certain statement his views are in consonance with those of his naval advisers, and they will not continue to vote money unless they do believe that the naval Officers approve of the way in which it is being spent, and of the amounts which are being asked for. I have not time, I am afraid, to go through the various questions as I should have liked to have done if you had not discussed them so kindly and so fully, but I cannot sit down without saying that I have been much pleased to find that there are so many of my brother Officers who do agree with me on one point or other, because I did not expect to find so much support to views which some may consider advanced. I find that Sir Houston Stewart, for instance, with all his experience, agrees with much that I have said. I find that while Captain Cleveland condemns open competition, Admiral Bowden-Smith is in favour of it, and even Sir George Willes admits that it must come.

Admiral Sir GEORGE WILLES: Unfortunately!

Admiral MAYNE: That may be: but what have I said? When a thing must come, the great thing is to smooth the way for it. What we are trying to do every day is to say such and such a thing must come; if we hand it over to the others, then good bye to all checks. If we face it, and say that it must come, then there is a possibility of guiding it and keeping it within moderate bounds. My view is this: I have heard that the artillery and the engineers consider themselves no worse for competitive examination; they have had it, and if so why should not we be in the same position? I think it would do us no harm at all. As to various types of ships, there are differences of opinion. There is one point on which Sir Houston Stewart touched that I may say a word about, that is the armour belt, and I should like to say upon it—what I have written about it before—my feeling is not that I want to do away with anybody's particular hobby if they like to have 6 feet or 6 inches of armour round one particular place, but that if you are to have the ships able to maintain such a high rate of speed at sea continuously, as Captain Jackson spoke of, then you must have them long, and if you have them so long as to do that, then you cannot carry the belt. Already you are obliged to say, "Shall we have it two-thirds, or shall we put it on the middle?" and one Officer says, "I do not mind how low it is; I should like it all below water-line;" and the next says, "What is the good of that? There is none above the water-line." So that at the present moment you are seeking to put weights into ships which they cannot carry, and, as experience has shown, water-line hits are comparatively very few. My view is to have a curved steel deck springing from well below the water-line, covering the engines, and then as much protection as you can carry round the guns, is the best thing. I thank you for the attention you have given me.

The CHAIRMAN: I am sure you will allow me to return your thanks to Admiral Mayne for his comprehensive and able lecture.

NAVAL PRIZE ESSAY.

"THE MARITIME DEFENCE OF THE UNITED KINGDOM
(INCLUDING ITS COLONIES AND DEPENDENCIES)
AND ITS TRADE IN A WAR WITH A GREAT MARI-
TIME POWER, SHOWING THE FLEET CONSIDERED
NECESSARY AND ITS DISPOSITION."

By Captain HENRY F. CLEVELAND, R.N.

Nemo me impune lacessit.

Introduction.

In face of the large armaments of our Continental neighbours, and the consequent danger to which, as a nation, we have been exposed for years, it would scarcely be believed that no Plan of defence, providing for the comprehensive organization of all the forces of this Empire, on a scale commensurate with the interests at stake, had, until very recently, been seriously considered; there was no standard policy of ship building, simply because no one knew what the requirements of the Naval Service were. There was no lack of discussion; Committees and Commissions—notably that of 1859-60—deliberated, but all failed to solve the problem of Imperial defence, from their inability to grasp the fact that a free and uninterrupted communication with the outer world was a matter of life and death to the people of the United Kingdom, two-thirds of whom depended upon it for their daily food and the raw material with which to carry on their ordinary industries. Subject to this delusion, they ignored the possibility of the nation being simply starved into submission, and concentrated their energies upon the erection of fortifications costing nearly twelve millions, with the one object of averting a possible—but highly improbable—invasion, and which we are now told are inadequate, those on the land front being, for the purposes of defence, practically useless. The result was, the Navy, necessarily the first (and, so far as this country is concerned, *the only*) line of defence, was starved, coaling stations and trade routes neglected, till the admirable Report of Lord Carnarvon's Committee of 1879 awoke the nation out of its lethargy. The present Administration has done much to redeem

the past. The "sit and wait" policy has been abandoned, a large programme of ship-building has been launched, and none too soon. Arrangements for mobilizing our ships and men have been organized, and worked with considerable success; dockyard administration has been improved, and many minor reforms initiated by the present Board of Admiralty, but much remains to be done if we are to maintain our influence and our Empire intact. A higher standard of training and responsibility must be insisted upon; the latter, glibly used but having little significance, must be brought more home to the minds and pockets of officials, not only in its present but in its future incidence. Centralization, the growth of a Parliamentary Government, must be relaxed, and greater power delegated to the Commanders-in-Chief, especially to those at the home ports, whose duties require considerable reorganization. Our peace establishments require to be more adapted for rapid expansion on an emergency; our foreign "stations," organized when there was neither the electric telegraph nor rapid and frequent steam communication, should, in conjunction with the Foreign and Colonial Offices, be reconstructed, with greater reference to the protection of trade routes; stationing small vessels (useless for all war purposes, and destructive to health and discipline) at isolated ports during peace should be discontinued, "Training squadrons" being substituted to visit them periodically; greater caution is needed in reproducing new types of vessels and appropriating new types of guns, engines, and stores to sea-going ships before they have been thoroughly tested at home; and, finally, every Colony and Dependency should contribute in men and money towards the defence of the Empire in proportion to their sea trade.

In estimating the amount of the forces requisite for the defence of this Empire, it may be taken for granted that we shall never engage in an aggressive war; we have inherited great possessions—the largest the world has ever seen—and our sole interest is to protect, inter-communicate, and consolidate them. Any plan of defence must rest upon this basis; in it must first be laid down the operations necessary to be undertaken, "the work to be done," and the force, in ships and men, requisite to carry it out; any attempt to regulate this force by reference to the war resources of our possible enemies must be misleading. Nor must we trust to any diplomatic devices, such as the Declaration of Paris of 1856, to evade our responsibilities; all such documents, purporting to limit the free action of States in the operation of war, are worthless; they would be discarded by the nation whose freedom was curtailed by their provisions. To what limitation would the vague term "contraband of war" be confined? Of course it would include every article the supply of which tended to prolong the war and injure the enemy. Food and raw material for industrial purposes would be no safer in a neutral bottom than coal and war matériel. Privateers, probably under some modern guise, would swarm as of old in the narrow seas, regardless of all paper prohibitions. The Government must be prepared to face this; its primary duty is to protect the persons and property of all British subjects, on shore or afloat, and if unable to effect this by insufficiency of means

and neglect of organization, any unavoidable loss, injury, or capture, arising in consequence, is entitled to compensation by the State; thus war rates of insurance, increased freights, and high prices of the necessaries of life will be obviated. Our Imperial responsibilities are undoubtedly great, but our resources are enormous. *Organization* is all that is required. Every portion of our Empire, however small, must unite in its defence; Continental alliances and intrigues must be discarded, and the great Anglo-Saxon race, federated in the interests of peace, should have a voice in the Declaration of War.

Arrangement of the Subject.

The subject has been arranged in two divisions:—

A. The "*Work*" which would have to be done in the event of a great maritime war, and

B. The "*Force*" required to carry it out.

To make the discussion still clearer, these have been subdivided into different sections.

Explanation of Tables.—Table I shows the present available maritime force—matériel—of four great naval Powers, for the purpose of comparison.

Table II is the *summary* of the whole subject. In it will be found the "*work*" to be done; the "*arsenals*," "*repairing yards*," "*coaling stations*," "*commercial dépôts*," and trade routes to be defended, and the "*force*" in ships and men required to do it. The term "*cruizer*" may be taken in a broad sense. The "*first class*," however, refers to powerful war-vessels, belted or protected. The "*second class*" may include *fast* merchant vessels, but it is very doubtful to what extent these may be available in war, being required for commercial purposes. The "*third class*" includes *fast* sloops, and even steam yachts appropriately armed.

The Map.—In the map (see *ante*, Pl. V) are shown the "*arsenals*" and "*repairing yards*," thus ●; the coaling stations and strategical bases thus ×. The main trade routes in full red lines, and the branch in dotted red lines.

(A.)

The Work required to be done to ensure an efficient Maritime Defence of the Empire—the Protection of its Territory, its Trade, Food Supplies, and Industries—in the event of a War with a great Maritime Power.

I. To protect (a) 24 arsenals and repairing yards (public and private); (b) 25 coaling stations or strategic bases (not included in (a)); (c) 23 commercial centres (not included in (a) and (b)); and (d) coast towns.

Introduction to (a) and (b).—The absolute necessity of our ships (public and private) having harbours in which they can refit and coal

in safety during war is undeniable; and, consequently, their protection is imperative. Whether this can best (most economically as well as efficiently) be effected by active or passive defences is a moot point, and will be discussed hereafter; suffice it to say that, so long as we hold the supremacy of the sea, and are consequently able to blockade the enemy within his ports, no organized attack will or can be made upon any part of our territories; but we ought to be prepared against a "rush" upon our arsenals in the event of our blockading fleets receiving a temporary check, and also against raiders who, in spite of the greatest vigilance in the Blockade, are sure to escape, although, cut off from their coal supplies, their career ought to be short. The sites of the "repairing yards" have been selected with reference to the great trade routes passing near them and the plant already in existence, and the "coaling stations" with reference to the trade routes emanating from them, and the average coal endurance of our war-ships.

(a.) *Arsenals and Repairing Yards (Public and Private).*

Most of the places named¹ are already established as building and repairing yards. Some are deficient in dock accommodation, which, in conjunction with private enterprise at the port, should be remedied without further delay. Some of the yards named are in the hands of private firms. With our vast public requirements of ships, guns, and docks, private co-operation is most essential, and should be far more encouraged than it is at present, the Government giving a guarantee of employment subject to priority of use during war. Sheerness as a public dockyard should be disestablished without delay; Chatham, when its access at *all* hours is facilitated by dredging, suffices for all public purposes. In view of the increasing traffic between China, Japan, and Vancouver, in consequence of the opening of the Canadian Pacific Railway, it is most important to have a repairing yard, as well as coaling station, in the north of China. Neutral ports will be closed to us, and to trust to the supply of coal from Hong Kong or Labuan by coal ships during war is, to say the least, very unreliable.

The island of Tsu-Sima, at the entrance to the Sea of Japan, is strategically the most suitable, and arrangements should be made for its purchase from the Japanese Government. Private enterprise might be induced to co-operate, as our merchants and shipowners will have large interests at stake, in a few years, in that part of the world.

The policy of retaining Malta as an arsenal, and Cyprus as a possession, except to exclude other nations, is very doubtful; they involve great expense during peace, and an enormous responsibility in war, without any apparent commensurate advantage. It would be

¹ Portsmouth, Plymouth, Chatham, and Woolwich, Milford, Cork; Leith, Hull, Newcastle, Liverpool, Glasgow, Belfast (private yards); Gibraltar, Malta, Halifax, Bermuda, Jamaica, Bombay, Trincomalee, Singapore (private yard), Hong Kong, Tsu-Sima (Sea of Japan), Cape of Good Hope, Sydney, Esquimalt.

almost impracticable to guarantee the safe transit of the canal boats ("ditchers") through the Mediterranean in a general war, and from a strategical point of view the Mediterranean would be far more efficiently blockaded from Gibraltar and Aden as bases of operation. Existing arrangements have been accepted in Table II.

(b.) *Coaling Stations or Strategic Bases (not included in (a)).*

The coaling stations enumerated¹ connect our chief trading routes, and, taking the average coal endurance of our ships to be 4,000 miles (a liberal figure at present), their distance apart has been considered with reference to it. Our weakest position is in the Pacific, where the route connecting Australia with Vancouver and Panama (when the canal is finished, which it assuredly will be) is long, and at present open to attack. A coaling station should be established in the neighbourhood of the Sandwich Islands; if one of these could not be acquired by purchase, the Fanning Islands, further south, should be annexed. One of the islands (Taboga) in the Bay of Panama should also be acquired as a connecting link between the canal and Australia, and also the west coast of South America. When any difficulty exists in affording protection to coal stored by the shore, it should be deposited a mile or so inland, and connected by a tram rail with the beach. Although Ascension is strategically better situated than St. Helena for a strategic base, its capability of defence is inferior, and, as both stations are not required, Ascension should be disestablished. Alderney would only be required as a "coaling station" in the event of the blockade of an adjacent port. Mombasa is considered a better strategic position than the Seychelles, and will, moreover, become a position of importance as a trade centre. If any of these places are not at present suitable (by want of protection or otherwise) for the storage of coal and stores, coaling ships must be appropriated and despatched to the nearest protected port on the order to "mobilize."

(c.) *Commercial Centres (not included in (a) and (b)).*

The commercial depôts, where so much valuable movable property exists, and which consequently invite attack from raiders, are enumerated.² Those on the coast of the United Kingdom are most liable to attack, as, owing to the lack of coaling stations, the enemy's cruisers will be restricted to European waters. The defence of these

¹ Dover, Alderney, Portland, Falmouth, Holyhead, Londonderry, Bantry Bay, Sierra Leone, St. Helena or Ascension, Mauritius, Mombasa, Aden, Rangoon, Labuan, Port Moresby, Thursday Island, Fiji Islands, Melbourne, Albany, Wellington, Hobart Town, Falkland Islands, St. Lucia, W. I., Fanning Island (or preferably one of the Sandwich Islands), Taboga Island.

² Dublin, Waterford, Wexford, Barrow, Limerick, Guernsey and Jersey, Bristol Channel, the Tees' Approaches, the Wear's Approaches, Firth of the Tay, Firth of Moray, Entrance to St. Lawrence, Entrance to Bay Fundy, Demerara, Table Bay, Victoria (Canada), Auckland, Adelaide, Newcastle, Penang, Bay of Bengal.

ports should be provided for by the Government, but a portion of the expense should be borne by local rates. The defence should be of a "stationary" nature.

(d.) *Coast Towns.*

Coast towns, whither people resort for pleasure, and which therefore are presumably wealthy, will no doubt be liable to demands from Raiders for ransom, with the alternative of bombardment. However modern sentiment may be opposed to this mode of warfare, without question it will be carried out; of course, at the close of the war, the successful nation will demand heavy indemnity for property so ruthlessly destroyed, and, should any life be lost, through lack of proper and timely notice being given of the intention to fire on the town, the penalty of manslaughter may be exacted. Batteries should not be erected near these towns, nor should any demonstration of resistance be permitted unless the enemy effected a landing in force.

II. *To ensure a Free Communication between every portion of the Empire along Established Routes.*

History unmistakably points to the importance of the maintenance of communications between every portion of the Empire: in consequence of it Gibraltar was relieved in '89, '90, and '91, and held out; the French lost their colonies because their communications were cut; Minorca fell owing to failure in relieving it.

How much more important is it to the United Kingdom at the present day, when more than *one-half* of its population is dependent upon sea-borne food, and *three-fourths* for their regular employment upon the importation of the raw material. Even the raising of the prices of either of these imports would possibly lead to serious consequences.

This certainty of communication between all parts of this vast Empire can best be secured by an Order in Council establishing defined routes, along which all vessels (steamers) must travel, failing which they will, if captured, forfeit all claim to compensation.

These routes will be patrolled by fast cruisers; those from the Capes of Good Hope and Horn will converge on St. Paul's Island at a point marked "C" on the map; those from Sierra Leone and the West Indies will join this route prolonged at "B;" that from the Mediterranean will join the main route at "C," which will meet the routes from Bermuda and Halifax (off which all North American ships will rendezvous) at "A" off Cork, whence they will proceed up the St. George's and English Channels. The outward-bound traffic will take the reverse courses. A few statistics will impress the mind with the importance to the mother country of a free and uninterrupted communication with the outer world.

Statistics showing the Importance of Free Communication.—With a population of 37 millions, 20 millions are fed by sea-borne food. The value of the Imperial sea trade is computed at 120 millions

sterling, of which *one-half*, or 17l. per head of the population, is appropriated to Great Britain and *one-third* to the colonies. Of the former, 79 millions sterling represent the value of imported food and 48 millions for grain. One-half of our trade in manufactured articles is conducted with the colonies. The value of Imperial steam shipping afloat is estimated at 7 millions sterling; it comprises 6,650 steamers of about 7 millions tons, the steam tonnage of the whole world being estimated at 11 millions! In addition to the above we own 16,162 sailing vessels, representing a gross tonnage of about $3\frac{1}{2}$ millions! The entry and clearance of British shipping in our ports annually is 55 million tons.

Although our forefathers had not the same absolute necessity to keep their sea communications open—the country being more self-supporting—it is interesting, for the purpose of comparison and to indicate the rapidity of our growth as a commercial nation, and the tendency of our interests more and more seaward, to give corresponding statistics for the years 1801, 1830, and 1859.

Corresponding Statistics for 1801.—In 1801 the population was 16 millions. The value of the sea trade was about 25 millions sterling—or 4l. a head. 21,000 British ships, representing $3\frac{1}{4}$ million tons, were entered and cleared annually, and 1 in 23 of the population was fed on sea-borne food.

For 1830.—In 1830 the population had risen to 24 millions. The sea trade was valued at 115 millions sterling—5l. a head. 6 million tons of shipping was cleared annually, and 1 in 15 of the people depended for their sustenance upon sea-borne food.

Statistics for 1859.—In 1859 the population had only risen to 28 millions, the sea trade to 32 millions sterling—about 12l. a head, 24 million tons of shipping were cleared annually, and 1 in 3 of the population was fed from abroad.

From consideration of the above facts, it is evident that our dependence upon supplies from abroad has increased, and is increasing rapidly; and the urgent necessity it imposes upon our statesmen to organize a plan for permanently securing the free passage of food and raw material to our shores.

III. *Suppression of Privateering.*

Although this “work” would fall under the head of II, it is proposed to treat it exceptionally. The Treaty of Paris bound all European Powers to abolish privateering, but there are strong evidences that in the event of a great war it would be revived under some modern form. In all the old wars its depredations were most excessive. According to Mr. Norman, in his “*Corsairs of France*,” 10,871 British ships were captured between 1793 and 1815, the largest number captured in one year being 949—in 1797. It dropped to 387 in 1804, owing no doubt to increased vigilance on our part, but rose to 619 in 1810, and fell again to 317 captures in 1813. Some of these were in foreign parts, but the majority were in the narrow seas between the Scilly Isles and Yarmouth. As an indication of

the importance and popularity of this method of warfare, for which, it may be remarked, our Anglo-Saxon race once showed marked pre-eminence, it should be stated that in the above period—1793 to 1815—we captured 1,031 French privateers, carrying 9,400 guns and 69,147 men!

IV. *Blockading the Enemy within his Ports.*

Blockade the Surest Method of Defence.—It is an axiom of warfare that the best method of defence is a vigorous offence. "Beard the enemy in his den and never relax the grip," was the doctrine preached and practised by that great master of naval organization—Lord St. Vincent—and it may be taken for granted that the principles of war which prevailed in his day, and which resulted in such grand success, are equally as applicable to our present times. No doubt great changes have taken place in the structure, armaments, and locomotive powers of our ships, but their effect has chiefly been to diminish chance, to make all manœuvres more rapid, and *more certain*, and to place success in the hands of the ablest strategist and tactician. There have been of late some misgivings, arising from the failure of the British Fleet to keep the *quasi* enemy within the Irish Ports in 1888, as to the efficiency of "blockading" with our present war-ships; but it is a fallacy to draw any lesson, or attempt to deduce any rules, from those "manœuvres," the size and composition of the blockading squadrons being quite inadequate and unsuitable for the work.

Double the force the enemy has inside, is considered by our ablest tactician to be necessary for a blockading squadron; it should be composed, one-third of small vessels (torpedo gun-vessels) as an inner squadron, one-third ("cruizers") for the second line, and one-third battle-ships, forming the outer squadron, with a proportion of coaling, store, and ammunition and torpedo depôt vessels. And, further, as "coaling" at sea is next to a practical impossibility, to avoid detaching the ships to any distance, some suitable place in the neighbourhood of the blockaded port must be seized and appropriated for a temporary coaling station.

V. *The Organizing and Working an efficient System of Coast Signals, Telephones, and Telegraphs.*

So much depends upon the acquirement and transmission of accurate information during war, that a special organization should exist throughout the Empire for this purpose, both afloat and ashore; on every prominent point, within the reach of civilization, there should be a Signal station where day and night signals can be received and transmitted at all times, either by means of the telephone, telegraph, flags, semaphore, or flashing light. The staff should be under the control of the Naval Commander-in-Chief of the District, whose office should be open at all times for the receipt, sifting, and transmission of intelligence. In every merchant vessel, as

well as man-of-war, the person in charge of the watch (or some delegate) should be able to communicate by day and night any information it may be useful to give or receive from any British ship or signal station.

It is most desirable that some short and simple code shall be circulated for the use of *all* Services.

(B.)

The Size, Organization, and Disposition of the Force necessary to ensure an Efficient Maritime Defence.

The mobilization of our naval forces at home has been the best work of organization undertaken for many years, but it requires considerable development to make it complete and adapted to the circumstances of the period.

It must be extended to every part of the Empire, where men must be enrolled and drilled, and appropriated to special stations in the event of war.

Officers should be appropriated to their ships—and so noted in the Navy List—in the same manner as the men now are, and they ought to reside near the port to which they are mobilized.

The ships should have all their imperishable stores on board, and on the word, "Prepare to Mobilize" (which should always precede by some days the Executive order), the remaining stores should be "drawn," and the ships taken to allotted places alongside the dockyard to facilitate the shipping of men and stores. The Officers and men should previously have been drilled only in the use of the weapons with which their ship is armed, every person on board being instructed in the use of rifle and pistol, and the handling of the quick-firing gun. In twenty-four hours after Executive order, "Mobilize," has been received, every ship should go out of harbour, and within the next twenty-four hours have sailed for her destination under sealed orders.

The "Commands," both at home and abroad, require reorganization and extension of power; all the Defences, Signal stations, Reserves, and Dockyards (only so far as regards the refitting and repairing of ships in commission, and the Reserve) within his district, should be under his entire control. Our present arrangements involve a divided responsibility, which is fatal to efficiency, and wasteful of resources. The home districts should be defined with reference to the necessities of war.¹ The blockade of ports should be under the supreme control of the nearest Commander-in-Chief, whose duty it would then be to keep the squadron in an efficient condition. Their flag should fly in a battle-ship or protected cruiser, ready for sea within twenty-four hours or less, and for the purpose of assisting them in the mobilization, organization, and drilling of the Reserves, signalling, &c., a Chief of the Staff should be appointed.

¹ See "Summary" in Table II.

The submarine defences should be worked by trained torpedo-men, assisted by local fishermen and boatmen, under the supervision of a "Torpedo Captain" or Commander, who would have special charge of their "maintenance" and defence, the nearest dockyard supplying boats and tugs when required.

The force considered necessary for the "work" to be done will be briefly considered under different headings, the Summary in Table II giving details as to the number and class of ships required, as also the number of men. No particular nation has been assumed as an enemy, but possible contingencies have been foreseen and met. The total, though great, is not larger than the demand upon us in the last great war, when our population and trade were much smaller, and, moreover, when we were entirely dependent upon the resources of the mother country. Now we propose to look to our children for a share in the defence which they are all capable of giving, and, surrounded by such vast resources, the drain upon them will be scarcely felt.

I. *The Force Necessary to Protect (a) Arsenal and Repairing Yards, (b) Coaling Stations (in addition to "a"), and (c) Commercial Depôts.*

(a.) These arsenals and repairing yards must be protected by passive defences, supplemented by gun- and torpedo-boats; as has been previously observed, so long as we hold the supremacy of the sea, we have nothing to fear from any organized attack, but we must always be prepared for a temporary check, and even conceive a "rush" upon our vital points as a possibility. Permanent sea-defences, consisting of forts (on the sea-front) and submarine mines, are the most trustworthy.

The batteries need not be heavily armed, but in view of long-range guns throwing violent explosives to a great distance, they must be well advanced and supplemented by coast-defence vessels of the type of "Polyphemus." The submarine and Whitehead mine-fields must be laid, maintained, and protected by seamen, covered by small batteries of quick-firing guns.

The batteries should be manned by a few highly-trained gunners, supplemented by local forces, and the whole should be under the supreme control of the Naval Commander-in-Chief of the district.

The naval force necessary for this work is detailed in the Summary, Table II.

(b.) *Coaling Stations (in addition to above).*

In view of the possible expediency of shifting these stations, and the difficulty of manning permanent defences with reliable and well-trained men in tropical countries, *movable* batteries and mine-fields, supplemented by gun- and torpedo-boats, the "field" being "covered" by a battery of quick-firing guns, is considered the most economical (including efficiency) mode of defence. The force necessary is detailed in the Summary, Table II.

(c.) Commercial Depôts.

The same remarks apply to the protection of these depôts as to the coaling stations, stationary movable batteries of the "Polyphemus" type, supplemented by torpedo-boats and, where possible, a mine-field is the best form of defence, and lends itself more to any change.

The number of ships and men considered necessary for this "work" is detailed in the Summary, Table II.

II. The active force necessary to—

- (a.) Blockade the enemy within his ports.
- (b.) To patrol the trade routes.
- (c.) To suppress privateering.

(a.) The force necessary to blockade any port cannot absolutely be fixed till it is known what force the enemy has inside. It may be laid down as a rule that *double* the force of the blockaded will be required.

The base of the blockading squadron should be as near as circumstances will admit, and a stationary force must be detailed to protect it; not more than one-third of the squadron should be away at any one time for coaling and refitting.

When necessary, reliefs should be sent from the reserve squadrons kept at the Downs, Falmouth, and Gibraltar. Typical ports have been named in the Summary, Table II, and a typical blockading squadron assigned.

(b.) To Patrol the Trade Routes.

It is assumed that these routes will be laid down by an Order in Council, to facilitate their protection in war and their navigation in peace.

The main route, drawn in red on the map, should be laid down in mid-ocean, clear of all coasts.

Upon this all the branch routes should converge at fixed points.

As to the most efficient method of protecting these routes, the old system of convoys may be dismissed as inadequate to meet the present requirements of trade, which, it may be assumed, will be conducted almost entirely in steamers; the delay in assembling a convoy of steamers, and their varying speeds (rendering the keeping company impracticable), will alone condemn convoying as unsuitable to the present required rapidity of transport.

Patrolling by swift cruisers is the only efficient method of protecting these routes; one should always be stationed near the points of junction, marked A, B, and C, on the chart, and the number patrolling between these, and on the branch routes, must depend upon circumstances; the number laid down in the Summary, Table II, will probably be found sufficient.

Cruisers assigned to this duty should have ample sail, as well as steam, power; the upper masts and yards mechanically fitted to "strike" in a short time, and into a small space, when required to "clear for action."

(c.) *To suppress Privateering.*

The most effective method of suppressing privateering would be to destroy the vessels in their own ports (which probably would have no heavy defences), and failing this, in the narrow waters. Small craft—either torpedo gun-vessels or steam yachts armed with quick-firing guns—would be found most suitable, acting in concert with the coast signal stations. If privateers should molest the trade routes—which, owing to the distance from their coast, is improbable—they would be dealt with by the patrolling cruisers.

III. *To work the Coast Signals and Telegraphs.*

It has been assumed these would be worked by the Coastguard men, and, therefore, no extra men have been assigned for it.

In every part of the Empire an organization, similar to the Coastguard of the United Kingdom, should exist.

On every prominent point, in sight of which a trade route passes, a signal station should be established; these are as necessary for the safe conduct of commerce during war as lighthouses are for navigation.

Such a proportion of the Coastguard men as will ensure an efficient signalman being on watch at each station should be instructed in receiving and transmitting signals and telegraphs by day or night from some simple code familiar to public and private ships.

IV. *The Reserves.*

Reserves in ships and men are indispensable for any well-organized plan of defence.

In the first place, coincident with mobilization, *three* squadrons of reserve should be formed at Falmouth (or Plymouth or Milford), the Downs, and Gibraltar respectively, from which all casualties, reliefs, &c., to outside squadrons should be furnished. Ships should be fitting out and building in the proportion of one to three of each class in each reserve squadron to keep them complete. Coal, store, and ammunition ships, apart from those attached to the various squadrons, must be "taken up" and arrangements made to keep the numerous stations complete.

One-third of "The Reserves"—R.N. Reserve of both classes and Pensioners—should be summoned *as soon as* the first mobilization was completed, and put through a course of drill at the depôts of their respective districts, others being enrolled to take their place.

A bombarding squadron, consisting of small gunboats of the "Handy" class and armed with a single heavy gun—"Direct" and

High-angle fire being equally represented—should be organized at Portsmouth and Plymouth, and in addition to a countermining flotilla, held in readiness for despatch. Finally, more active steps should be taken throughout the Empire to enrol and organize the seafaring portion of the population for the work of defence within their own district.

There should be a boys' training ship (excellent institutions) at Leith or Aberdeen, Greenock, and Belfast, and the gun drills of all classes of men should be conducted on board a new type of vessel, visiting or stationed at central ports, not in batteries with obsolete guns. Fishermen are the class best suited for the work; accustomed to boats, acquainted with the tides and peculiarities of the coast, they are invaluable for coast defence. Take the United Kingdom alone, there are over 130,000 men and boys engaged in the fishing industry—46,000 in England, 53,000 in Scotland, and 31,000 in Ireland—only a very small proportion of these have been enrolled in the second class of the Royal Naval Reserve! When we look further afield—to the large fishing industry of Canada, for instance—how few of those men do we find enrolled and organized for the protection of their property! The same lack of organization prevails throughout the Empire, not from want of energy but of appreciation of the gravity of the situation.

To be prepared for war every detail must be worked out during peace, and all naval and military administration directed to this possibility. Then—and then only—shall we be able to say to the whole world, in the words of the motto, "No one can touch me with impunity."

TABLE I.—*Number and Class of the War-Ships of England, France, Russia, and Italy.*

Nation.	Battle-ships.		Cruisers (over 1,500 tons).		Sea-going vessels for cruising, under 1500 tons.	Coast defence vessels.				Merchant vessels available for war purposes.	Not ascertained.	
	In and ready for commis- sion.	Under repair and building.	In and ready for commis- sion.	Under repair and building.		Armoured. Unarmoured.	Armoured vessels.	Gunboats.	Torpedo-boats.			
									1st Class.			2nd Class.
England	33	$\left. \begin{array}{l} 4+10^* \\ 14 \end{array} \right\}$	$\left. \begin{array}{l} 18 \\ 42 \\ 60 \end{array} \right\}$	$\left. \begin{array}{l} 27+42^* \\ 69 \end{array} \right\}$	$\left. \begin{array}{l} \text{Torpedo gun-vessels,} \\ 15+18^* \\ 33 \\ \text{Gun-vessels and} \\ \text{gun-boats, 75} \\ \text{Troop and store, 14} \\ \text{Building, 18} \end{array} \right\}$	18	54	$\left. \begin{array}{l} 80+6^* \\ 86 \end{array} \right\}$	$\left. \begin{array}{l} 51+10^* \\ 61 \end{array} \right\}$	6 subsidized 19 others available		
France— Cherbourg... Brest..... Rochefort... L'Orient... Toulon.....	$\left. \begin{array}{l} 5 \\ 4 \\ 24 \\ 15 \end{array} \right\}$	8	7	41	21	$\left. \begin{array}{l} \text{Torpedo g.-v., 8} \\ \text{Others, 35} \\ 13 \text{ building} \end{array} \right\}$	$\left. \begin{array}{l} 4+2 \text{ b'lding} \\ 2+2 \text{ " } \\ 2 \text{ Total, 14.} \end{array} \right\}$	37	115	51		
Russia— The Baltic .. Black Sea ...	$\left. \begin{array}{l} 6 \\ 3 \end{array} \right\}$	$\left. \begin{array}{l} 3 \\ 4 \\ 1 \end{array} \right\}$	$\left. \begin{array}{l} 7 \\ 14 \\ 3 \end{array} \right\}$	$\left. \begin{array}{l} 17 \\ 3 \end{array} \right\}$	$\left. \begin{array}{l} 2 \\ 2 \end{array} \right\}$	$\left. \begin{array}{l} 74 \\ 3 \end{array} \right\}$	$\left. \begin{array}{l} 20+2 \text{ b'lding} \\ 2 \text{ Total, 24} \end{array} \right\}$	25+6 b'lding 2 Total, 24	134†	79		
Italy	10	3	4	20§	..	$\left. \begin{array}{l} \text{Torpedo g.-v., 9} \\ \text{Sloops, 24} \end{array} \right\}$	4	16	130	—		

* New programme.

† 3 Torpedo gun-vessels.

‡ 3 Submarine building.

§ 5 of these are not completed.

* New programme. † 3 Torpedo gun-vessels. ‡ 3 Submarine building. § 5 of these are not completed.

TABLE II.—*Summary of Imperial Maritime Defence in the Event of "Mobilizing" for a War with a Great Maritime Power.*

The "Command," its limits and Head-quarters.	"Work" to be done.	"Force" required to do it.																
		(a.) Defence of arsenals, repairing yards, and docks.	(b.) Protecting coaling stations.	(c.) Protecting commer- cial depôts.	(d.) Patrolling trade routes.	(e.) Blockading.	(f.) Reserves.	"Cruisers," subsidized merchant vessels or steam yachts.		Torpedo gun-vessels.	Coal ships.	Store and ammunition.	Torpedo depôts.	Local defence.			Number of men required.	
								Belled or protected.	2nd Class.					3rd Class.	"Coast defence" (armoured, of "Poly- phemus" type).	Gunboats.		Torpedo-boats.	Flotilla for mine- field.
The "S.E." Portland Bill— Alderney to N Foreland— Ostend. — Portsmouth.	Portland and Dover. Alderney. The Downs.	(a.) Portsmouth .....	..	..	..	..	..	..	..	..	..	..	..	2	2	4	4	500
		(b.) { Portland .....	..	..	..	..	..	..	..	..	..	..	..	1	..	2	3	240
		(c.) { Alderney .....	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	200
		(d.) { Dover .....	..	..	..	3	3	..	..	..	..	..	..	..	..	1	2	66
The "S.W." Scilly Islands— C. Finisterre to Portland Bill— Alderney— Plymouth.	Portland and Plymouth. Falmouth. Nearest Islands and Plymouth. Falmouth.	(e.) Channel within limits	..	..	..	3	3	..	..	..	..	..	..	..	..	..	..	840
		(f.) Blockading, M.....	2	4	4	10	2	1	1	1	1	..	..	..	..	..	..	8000
		(g.) Reserve Squadron ...	2	2	2	6	2	1	1	1	1	..	..	..	..	..	..	5000
		(h.) Plymouth.....	..	..	..	..	..	..	..	..	..	..	..	1	2	4	4	320
The "S.E." Scilly Islands— C. Finisterre to Portland Bill— Alderney— Plymouth.	Portland and Plymouth. Falmouth. Nearest Islands and Plymouth. Falmouth.	(i.) Falmouth.....	..	..	..	2	..	..	..	..	..	..	..	1	..	2	..	180
		(j.) Guernsey and Jersey.	..	..	2	..	..	..	..	..	..	..	..	..	2	2	..	500
		(k.) Channel within limits	1	2	2	6	2	1	1	1	1	..	..	..	..	..	..	1400
		(l.) { N.....	6	2	2	3	1	1	1	1	1	..	..	..	..	..	..	5200
The "S.W." Scilly Islands— C. Finisterre to Portland Bill— Alderney— Plymouth.	Portland and Plymouth. Falmouth. Nearest Islands and Plymouth. Falmouth.	(m.) Blockading { O.....	2	2	2	3	1	1	1	1	1	1	1	..	..	..	..	3000
		(n.) { P.....	2	2	2	3	1	1	1	1	1	1	1	1	..	..	..	3000
		(o.) Reserve Squadron...	2	2	2	6	2	1	1	1	1	1	1	1	..	..	..	5000
		(p.) Reserve Squadron...	6	2	2	6	2	1	1	1	1	1	1	1	..	..	..	5000

HOME.

[illegible]

TABLE II—continued.

The "Command," its limits and Head-quarters.	"Work" to be done.		"Force" required to do it.										Number of men required.				
	Base of operations.	(a.) Defence of arsenals, repairing yards, and docks. (b.) Protecting coaling stations. (c.) Protecting commer- cial depôts, (d.) Patrolling trade routes. (e.) Blockading. (f.) Reserves.	Battle-ships.	"Cruisers," subsidized merchant vessels or steam yachts.			Torpedo gun-vessels.	Coal ships.	Store and ammunition.	Torpedo depôts.	Local defence.						
				Belled or protected.	2nd Class.	3rd Class.					"Coast defence" (armoured, of "Poly- phemus" type).	Gunboats.	Torpedo-boats.	Flotilla for mine-field.			
"The N. Atlantic." — The Equator to 60° N.— West Coast of Africa to American Coast. — Bernuda.	C. Breton St. John, N.B. St. John's, N.F. Jamaica. St. Lucia. Sierra Leone. St. Lucia. Bernuda. Halifax.	(a.) Halifax..... Bernuda..... Jamaica..... (b.) S. Lucia, Sierra Leone (c.) Entrance R. St. Law- rence .....	..	..	..	..	..	..	..	..	..	1	..	2	3	250	
			..	..	..	..	..	..	..	..	..	..	1	..	2	3	250
			..	..	..	..	..	..	..	..	..	..	1	..	2	3	250
			..	..	..	..	..	..	..	..	..	..	1	..	2	3	250
			1	..	2	..	..	..	..	..	..	..	..	2	4	..	1000
			..	2	..	..	..	..	..	..	..	..	..	2	4	..	530
			..	..	..	..	..	..	..	..	..	..	1	..	2	..	200
			..	2	..	..	..	..	..	..	..	..	..	2	..	..	450
			1	1	2	..	..	..	..	..	..	..	..	2	..	..	1140
			..	2	1
— Bernuda.	Sierra Leone. St. Lucia. Bernuda. Halifax.	(d.) Sierra Leone—B route..... St. Lucia—B route.. C—B route..... Bernuda—A to 30° W..... Halifax—A to 30° W.	1	1	1	..	..	..	..	..	..	..	..	..	..	1100	
			..	2	1	..	..	..	..	..	..	..	..	..	..	800	
			..	1	..	..	..	..	..	..	..	..	..	..	..	..	500
			..	2	..	..	..	..	..	..	..	..	..	..	..	..	400
			..	1	2	..	..	..	..	..	..	..	..	..	..	700	

[illegible]

TABLE II—continued.

The "Command," its limits and Head-quarters.	"Work" to be done.		"Force" required to do it.																			
			(a.) Defence of arsenals, repairing yards, and docks.	(b.) Protecting coaling stations.	(c.) Protecting commer- cial depôts, trade routes.	(d.) Patrolling routes.	(e.) Blockading.	(f.) Reserves.	Battle-ships.	"Cruisers," subsidized merchant vessels or steam yachts.			Torpedo gun-vessels.	Coal ships.	Store and ammunition.	Torpedo depôts.	Local defence.				Number of men required.	
										Belted or protected.	2nd Class.	3rd Class.					Gunboats.	Torpedo-boats.	Flotilla for mine-field.			
"The North Pacific." Equator— Behring S. Asia—America. Hong Kong and Esquimalt.	Labuan. Both. Singapore. Hong Kong and Tsu-Sima. Tsu-Sima and Esquimalt. Esquimalt.	(a.) Hong Kong .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	4	4	4	380	
		Esquimalt .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	3	250
		Singapore (Private Yard) .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	3	270
		(b.) Fanning Islands. ....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	3	250
		Tsu-Sima (Japan) ....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	3	450
		Labuan .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	3	270
		(c.) North Borneo .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	3	100
		(d.) Singapore—Hong Kong .....	..	1	2	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	1430
		Singapore—Labuan ..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	400
		Hong Kong—Japan ..	..	1	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1100
Japan—Vancouver ..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	700	
	Fanning Islands— Vancouver .....	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	400	

NAVAL ESSAY.

By Lieutenant E. E. BRADFORD, R.N.

“ The Navy, whereon, under the good providence of God, the wealth, safety, and strength of these kingdoms chiefly depend.”

In considering a scheme of defence for any position, the first question that naturally arises in the mind is, as to what points are most exposed to attack; it is consequently desirable to settle this in the beginning by a short inquiry.

Military experts, both at home and abroad, candidly tell us that we are open to invasion, and various computations have been made as to the period required for the landing of an overpowering force on our shores, and certainly there can be no doubt that, with Europe in arms around us, the necessary forces are immediately available, though as to whether the requisite transport can be obtained as rapidly, is another question. But seeing how such a flotilla might even be collected from our own mercantile marine in the event of the tide of war setting against us, or from the construction of such craft as are good enough for such a temporary purpose, it is evident that such a disaster is within the bounds of possibility, however little we may have been subjected to it hitherto.

There are two striking instances of attempted invasion in our history, from which a lesson may be learnt for the future. The first occurred in 1588, when Spain, the supreme maritime Power of the day, put forth her strength to subdue and convert us, and equipped her vast Armada—an expedition that was harried and chased from Land's End to John o'Groat's House, by an inferior force, dispersed and destroyed without an opportunity to effect a landing. The second was in 1805, when, after long preparation and the formation of a coalition against us, Napoleon was forced to abandon his cherished scheme of the conquest of these islands, on finding that, in spite of an overwhelming superiority of numbers, he could not obtain the mastery of the Channel for the period he required, and which he is said to have stated to be six days.

The first case is an instance of the disaster attendant on the disregard of the principle that local maritime supremacy is absolutely necessary to the success of an expedition across the sea. The second

is an instance of its recognition and acceptance by the most daring and skilful leader of the age.

The lesson is that, so long as our Navy is strong enough to prevent another Power acquiring this supremacy, our shores may be regarded as safe from invasion.

Of our colonies, some are large self-governing communities, whose capabilities of defence, and whose distance from any possible foe, preclude the thought of any attempt being made to invade them; others are without these natural means of defence, and from their size and situation can never be considered as other than dependencies. While throughout them all, and on our own shores as well, there are situated the great seaports, the commercial depôts open to heavy squeezing for ransom at the option of a bombardment and ruin.

The position of our small colonies, when attacked, may be compared to that of a besieged fortress on land, in that its capitulation, unless relieved, is only a matter of time. Fortifications will of course prolong the period and necessitate greater caution, but given the time, mine-fields can be cleared, obstructions removed, stores will become exhausted, and even, if the forts cannot be turned, the place can be starved into submission, so that the result is the same. The performance of such an operation, however, involves the separation of the ships of the attacking force, the disorganization of their crews, and the expenditure of ammunition that can be ill-spared from a modern ship equipment. A fleet engaged in such an attack would be placed at a perilous disadvantage in the event of the arrival of a hostile fleet or squadron.

These remarks hold equally good in the case of bombardment of seaports and coast towns, though the period required would be of much shorter duration. Single ships or small squadrons may attempt to "rummage" our ports, but with the ample means of communication round our coasts that we possess, such a career of destruction, with our ships properly stationed, would meet with a speedy end. Abroad, the defence of such places can be considered conjointly with that of the shipping.

Our shipping numbers three-fourths that of the whole world, and extends "where'er a vessel spreads a sail," of whose well-worn tracks it may be said as of roads to Rome, that they all lead to London; the various units thronging closer and closer as they approach the United Kingdom, each unit offering a point to attack, a booty to capture, and the opportunity to drive home another nail in the coffin of our maritime supremacy. It is one of the great sources of our wealth and prosperity, whose partial stoppage will throw great numbers of people out of employment, thus lowering the rates of wages, while the scarcity of food will cause a rise in the prices. It cannot be abandoned nor transferred; ships so sold in time of war being still liable to confiscation. How is it to be protected?

The most effective means of accomplishing such a desirable result would obviously be the close blockading of our enemy's ports; and though the absolute fulfilment of such an undertaking is impracticable, the attempt must be made, as the only alternative is convoy,

which would entail the employment of a larger force, and necessitate the absence of the Channel Fleet from our own shores, and consequent loss of touch with the enemy, and may therefore be dismissed as still more impracticable.

If a blockade is to be established, then it will be well to inquire into the difficulties and obstacles in the way, with a view to seeing what further steps will be necessary; they may be stated to be somewhat as follows:—

The form of attack developed by the introduction of locomotive-torpedoes and torpedo-boats is particularly well adapted to the use of a blockaded force, especially on dark nights or in thick weather, and will cause a very heavy physical and mental strain on the ships' companies, while the anticipation of the effects of a "bit" may seriously affect the morale of a crew worn down by constant watching and anxiety.

The impossibility of keeping clean fires and a head of steam for emergency when cruising at low speeds, exposes the blockading force to attack at a disadvantage.

The necessity of ships leaving their stations to refill their coal bunkers, or to repair damages at the base, will sooner or later place the blockading force at a disadvantage, and will sometimes cause the port to be left insufficiently blocked.

However destructive the damage caused by the explosion of a locomotive-torpedo may be, its range is very limited, and if torpedo-boats can be prevented from approaching within range, they can do but little harm. From the experience of the late manœuvres there is good reason to suppose that this may be best accomplished by the employment of fast, light-draught, handy gun-vessels, and by the fullest development of the powers of modern ordnance that can be obtained by a close attention to gunnery practice. The net defence is an admirable protection against torpedoes for ships at anchor, and no pains should be spared to simplify the method and expedite the time of rigging it out, but it is not adapted for use at sea, owing to the loss of speed and manœuvring power, nor has any plan been devised for keeping it in its place when under way. A minute internal watertight subdivision affords the best method of safety to a ship exposed to such attack.

The "morale" of a ship's company chiefly depends on the stuff it is made of, and the state of discipline maintained, which latter may be greatly assisted by an organization allowing of rest and relief, while maintaining an efficient system of look-out. Our forefathers, who achieved such great feats, had recourse to very severe measures for the preservation of discipline in their ships, but it may be hoped that the spread of education has rendered unnecessary any severer measures than are now found to suffice.

Thick weather and dark nights may afford facilities for attack by torpedo-boat, but such conditions operate for both sides alike, and a boat will experience unwonted difficulty in finding a fleet whose whereabouts is not known within a radius of 10 or 15 miles, and which proceeds without light or sound. Search lights may be of use to the

blockading fleet on some of these occasions, but the difficulty of keeping them fixed on a moving object, the total darkness enshrouding everything else, and the exposure of position caused by their display, render their use of very doubtful advantage.

The inability to move at high speed on short notice, when fires have been banked for any time, is a disadvantage, and an attack by torpedo-boats, under such circumstances, must be repelled by guns. The danger may also be partly obviated by the withdrawal of the fleet to a greater distance from the port, provided it be not left too open; cruisers and others employed inshore must indulge in occasional runs at high speed to clean their fires. With regard to the danger of attack from the enemy's ships that this disadvantage exposes the blockading force, a proper chain of communication between the fleet and the squadrons and ships inshore should enable the former to be kept informed of any expected or observed movements in sufficient time to allow of some preparation. It should also be remembered that the enemy's ultimate object must be to get out, with as little harm as can be, for the purpose of effecting some strategic movement, and that however many feints may be made of coming out, a serious action is not likely to be permitted unless in great superiority. So this disadvantage need not count for much so far as attack is concerned.

Many systems have been advocated for replenishing the coal supply of a fleet at sea, but none can be said to have overcome the difficulties in the way of its accomplishment in a swell or seaway, of keeping ships sufficiently close without injury, nor of maintaining a supply fast enough, and the idea may be condemned as impracticable for general purposes. The only alternative is to afford all possible facilities for coaling at some harbour which shall combine the conditions of capability of easy defence, shelter, and proximity to the scene of operations. The number of ships required will, in great measure, depend on the latter condition, hence it is of great importance that a base should be obtained when the occasion requires it.

On the other hand, steam propulsion and improved means of navigation enable the blockader to maintain his station with a far greater certainty than in the days of lee-shores, lee-tides, and calms, while of modern weapons the mechanical mine is a most effective weapon for accomplishing the purpose of a blockader, but whose development does not seem to attract the attention it merits.

It may also be remarked that, within the last thirty years, the biggest thing in blockade ever seen has been performed with success, and this by a power quite unprepared at the outset.

If the above arguments have been fairly stated, it would appear that the dangers and difficulties of blockading are not such as cannot be guarded against nor overcome, and that a fleet can be maintained off a port close enough to afford a fair probability that no hostile fleet shall escape therefrom unfought.

But so long as there is any doubt about it, and in view of the probability of the enemy's cruisers, &c., being despatched to various parts of the world before the war breaks out, to say nothing of those who

succeed in breaking the blockade, it is evident that our naval supremacy is not secure, and as no other position for the fleet will have the effect of affording such protection to our trade, other steps must be taken to secure it.

So far as the preservation of the United Kingdom is concerned, this must be accomplished by the maintenance of a reserve fleet in home waters. With regard to the shipping, the colonies and coaling bases, the maritime defence of the latter may, with the addition of a few torpedo-boats, be considered as provided for by that of the shipping. This will require the patrol of the ocean routes, particularly in the North Atlantic, and the maintenance of strong squadrons at the commanding points on the foreign stations. It has been our practice in the war scares of the last few years to detail our cruisers in foreign waters to the duty of watching and following such of the enemy's ships as are on the station. This proceeding has been aptly described as "shadowing," and must be resumed whenever our relations with another Power are getting critical, the strength of the foreign squadrons in peace-time being sufficiently maintained to admit of it.

The Naval Stations.

The existing arrangement and limits of the naval stations do not readily lend themselves to a scheme of defence for commerce, &c. The Cape of Good Hope and Pacific stations are too large to allow the Commanders-in-Chief to exercise a control throughout, while the distances are too great to enable ships to concentrate rapidly in an emergency. Through the north-west corner of the former station there passes a trade whose protection should not be performed by the squadron whose headquarters are at the Cape.

The Home station extends a long leg southwards in the middle of the Atlantic, which might be cut off with advantage.

The East Indies station, Australia, and South-east Coast of America stations may be rearranged with advantage on other grounds.

The following are the alterations proposed, as remedying in some degree the present defects. The stations as altered being defined by dotted lines in the accompanying chart of the world (see *ante*, Plate V).

The establishment of a command in the Atlantic extending from the 20th parallel north to the 20th parallel south, and from the West Coast of Africa to the East Coast of South America as far as the meridian 40° E., to have its headquarters at Sierra Leone, a dépôt at St. Helena, and to be called the Mid-Atlantic station. This may not be quite so salubrious an arrangement as at present exists, but the importance of holding the pass from the North to the South Atlantic and beyond is too great to be disregarded for such considerations.

The South-east Coast of America to be called the South American station, and to be extended to include the East and West Coasts from the 20th parallel of south latitude in the South Atlantic to the equator in the Pacific, and from the meridian of 25° W. to that of 125° W.

The Cape of Good Hope station will remain as at present, less the extent above described.

At present the Red Sea lies within the limits of the Mediterranean station, connected therewith by the Suez Canal, which it will be necessary to guard at both ends. If the Canal becomes blocked the ships at the southern end will not be required there, but will be cut off from their station at a time when possibly their services are urgently required elsewhere. Hence it is desirable that the Red Sea should be included within the limits of the East Indian station.

Australia and New Zealand are daily acquiring a greater interest in the islands of the South Pacific, which may be expected to extend to the most eastern groups, and become paramount in a few years. South America having little or no interest therein it is proposed that the Australian station be extended eastwards as far as the meridian 125° W.

Communications.

The importance of a complete and reliable system of telegraphic communication between all parts of the world can hardly be overestimated. By its means the Intelligence Department will be able to keep recorded the changes of position of every hostile ship, notifying the respective Commanders-in-Chief of the probable advent of any such within the limits of their stations, enabling measures for forestalling them to be taken in due time, thus effecting a saving in the number of ships required by more fully developing their power of mobility. It will further afford the means of directing a rapid concentration for the attack of a weak point temporarily exposed, or for the defence of a point threatened, while the want of it may cause the golden opportunity to be lost.

The existing system of submarine cables can hardly be considered complete while such stations as Mauritius and Bermuda are not included, nor to offer such security by duplication as to be reliable as long as our own cables to the East all lie in one road. The following extensions are therefore proposed, as marked in the chart of the world by dotted blue lines :—

A cable from Halifax to Jamaica *via* Bermuda and the Bahamas, to join up with the existing lines in the West Indies, and obviate the untrustworthy means of communication over a foreign soil.

A cable from Gibraltar to Sierra Leone to join up with the new West African system (lately extended to the Cape). The present cable passes from Lisbon through St. Vincent in the Cape de Verd Islands, a way that might be closed in time of war.

A cable from Port Natal to Ceylon *via* Mauritius and Diego Garcia, duplicating the existing system to India.

Growing interests in the Pacific require an extension of the telegraph system in that region. A cable from Vancouver to Brisbane or some other convenient point *via* Fiji will form a trunk, a line from which branches can afterwards be laid as required; the distances are long between the stations, and, if necessary, Honolulu can be brought

into the line. This will duplicate the system to Australia, and may be considered as triplicating that to India.

Hong Kong should be joined up with Singapore *viâ* Borneo and Labuan, instead of through the French colony at Saigon as at present.

Besides the development of the telegraphic system, there is an urgent need of a good and simple means of communication between ships of the mercantile marine and Royal Navy, in order to fully develop the protection afforded by patrols. Flags can be distinguished easily at long distances, but they necessitate the use of a code which may fall into the enemy's hands, the semaphore is good and easily learnt, but for general purposes the Colomb system is the best adapted in being applicable in so many ways.

Classification of Ships.

A scheme for the classification of ships according to their powers is desirable in estimating the "force necessary," and as the modern man-of-war is such an ever-varying compromise of thick armour, big guns, good coal stowage, high speed, and handiness, some common denominator is necessary on which their respective values may be calculated. Tonnage fulfils this condition better than anything else, but its application must be qualified by the consideration of special qualities.

The three principal types of ships are generally described as the battle-ship, the cruiser, and the gunboat, more properly called the gun-vessel.

The battle-ship must in the first place carry the most powerful weapons of offence and an adequate protection by armour or otherwise for her vital parts and gun emplacements; it would then be desirable to consider her coal endurance with reference to the limitations imposed on size by the requirements of good manœuvring power; but in a navy whose occupation in war-time will probably be that of blockading an enemy, every ship, while possessing the power to obtain a high speed, must attain a certain limit of coal endurance based on geographical considerations, and size must be increased to admit of it.

In order to ascertain what this minimum of coal endurance is, the distances between the principal strategical points in the North Atlantic and Mediterranean, as given in the accompanying tables, should be considered, and an allowance made for ships having to proceed from one point to another with bunkers partially exhausted through cruising or blockading.

6,000 miles is accordingly taken as the minimum coal radius of a battle-ship at 10 knots speed.

Distance Tables.

Port.										
	Plymouth									
Halifax	2442	Halifax								
Bermuda	2920	780	Bermuda							
Jamaica	4029	1801	1108	Jamaica						
Barbadoes	3538	1910	1185	1041	Barbadoes					
C. Verd Is.	2257	..	2359	..	2019	St. Vincent.	C. Verd Is.			
Sierra Leone	2740	..	3208	..	2751	855	Sierra Leone			
Gibraltar	1050	2710	2968	3963	3245	1565	1977 Gibraltar.			
	Gibraltar									
Toulon	705	Toulon								
Malta	980	705	Malta							
Bashika B.	1730	..	750	Bashika Bay						
Cyprus	1915	..	935	535	Cyprus					
Port Said	1920	1645	940	640	200	Port Said				

A reference to the types of battle-ships built during the last few years will show that this coal endurance can be obtained in combination with high speed and other conditions in a vessel of 9,000 tons displacement. All battle-ships of or above this tonnage should be placed in the first class, provided that they fulfil the above condition of coal endurance. Those ships whose tonnage qualifies them for the first class, but whose coal endurance is not up to the required standard, should be placed in the second or third class, according to other merits. Those below 9,000 tons with their endurance up to the standard, to be placed in the second class.

The necessities of good sea-keeping qualities, high speed, and long endurance in a vessel intended for chasing and cruising in distant parts of the world impose a lighter armament and protection in ships of the cruiser type. They may be divided into three classes, the first to consist of vessels of 5,000 tons and over, the second of those under 5,000 tons but over 2,000, the third of lighter vessels capable of performing the usual duties, but whose endurance should not be less than 5,000 miles.

The principal requirements of a gun-vessel are that she should be a good sea-boat, handy, and carry her guns well; but the attainment of special ends calls for the development of special qualities, leading to the establishment of different classes which can best be distinguished by their names, such as the torpedo gun-vessel, gunboat, despatch boat, or coast defence gunboat.

Disposition of the Force.

The following disposition and estimate of the force necessary is drawn up for each of the naval stations as above defined and limited.

In the event of the selection of a coaling station falling on a port in our own territory, it may be supposed that the Channel Fleet, our first line of defence, is lying there in company with a squadron of

cruizers and gun-vessels, and that stores of coal, ammunition, &c., with tug-boats and lighters, have been collected, and that a suitable means of defence by booms and guard-boats has been provided.

Should, however, the situation of the enemy's coast line be such that we can make no use of our own ports as a base wherefrom to attack him, we shall be put to the necessity of seizing one, an undertaking probably involving a considerable expedition.

In either case the first move of the Channel Fleet will be to take up a position off the enemy's ports so as to mask his ships, that is so as to blockade them or bring them to immediate action should they put to sea; if the expedition has been decided upon, the transports, store-ships, colliers, &c., convoyed by a squadron of cruizers, will proceed to their destination and effect the seizure of the desired position.

The formation and order to be observed in the Channel Fleet whilst engaged in masking may be best illustrated by an example. Supposing a fleet to be lying in Portsmouth Harbour, the approaches to which are defended by fortifications, that mine-fields have been laid down in the channels, electric-light stations erected, guard-boats detailed for watching, and that a flotilla of torpedo-boats is ready to act as required.

The masking fleet of battle-ships will then be stationed to cruise in an open formation admitting of independent movement on a south-westerly and north-easterly course from a position about ten miles south-east of Dunnose, in the Isle of Wight, with a cruizer stationed on each wing ready to move into support to act as repeating ship, or to chase, as required. Inshore of this fleet there will be two cruizers close enough in to support the inner squadron of fast, light draught, handy torpedo gun-vessels. These latter will be stationed in a curved line extending from the southward of Culver Cliff towards Selsea Bill, at a distance of two or three miles apart in the daytime, and of half that distance at night; they are to keep constantly on the move and give immediate notice to the cruizers outside of all movements observed. The approach to Spithead and Portsmouth, from the west, through the Solent, is not very suitable for heavy ships moving in company, but in the event of an attempt being made so to use it, the masking fleet may have notice from the gun-vessels looking into Spithead from the east, or from the squadron stationed off the mouth of the Channel, and will proceed in due force to the westward. Two cruizers and two torpedo gun-vessels will be stationed off the mouth of the Solent, whose especial duty it will be to chase or drive back cruizers and torpedo-boats attempting to escape, another cruizer being stationed to keep up the communications with the fleet. The accompanying plan shows the disposition of the various ships and squadrons.

It has been found by experience in the late naval manœuvres that torpedo-boats are not suitable vessels for maintaining an inshore squadron on account of the difficulties of re-coaling and re-watering them at sea, the necessity of rest or relief for the crew, and their insufficient sea-keeping qualities. They may, however, be used to great

advantage in harassing and worrying the enemy's guard-boats, provided the base be sufficiently near to admit of their acting independently therefrom.

On the first opportunity occurring the attacking force will collect all the available torpedo- and picket-boats, and an attack will be made on the enemy's guard-boats, by this flotilla, supported by the gun-vessels. Mechanical mines having been prepared, they will be placed in boats and laid under cover of this attack. On a signal being made the retreat of the gun-vessel will then be effected in a previously arranged direction, to avoid the mines, and they will take up their proper stations.

It is not to be expected that mines laid under such conditions will long remain efficient; but the suspicion of their presence will, nevertheless, act as a strong deterrent to the use of any channel so treated, until it has been countermined or swept, and the success attendant on their use such as to justify the repeating of the operation.

To take up some such position as this should be our first move on the outbreak of a war with a maritime Power. At the same time all his ports adjacent to the position will have to be watched or rummaged for stray torpedo-boats.

The position of the Reserve fleet maintained in home waters to ensure our maritime supremacy will depend on various circumstances. The Downs is a good general position, covering the south-east coast and approaches to London, but it is open and exposed, and if Dover be not large enough to hold it, Portsmouth or Sheerness must be used as headquarters. The ships should be kept together as much as possible and be continually exercised in drills and manœuvres, its strength being such as to enable it to engage the enemy on even terms in the event of the latter's succeeding in evading or defeating the Channel Fleet.

The strength of the fleet required to mask an enemy's ships depends on the strength of the force to be masked, the distance of the scene of operations from the base, and the number and extent of the approaches to the port. It has been laid down by the Committee appointed to consider the Report of the Naval Manœuvres, 1888, to be in the proportion of five to three in battle-ships, where the area to be covered by the blockaders is not extensive, the number of cruisers, &c., for the maintenance of the inshore squadron being equal to that of the battle-ships, while to ensure "having sufficient force to follow the enemy's cruisers without detriment to their general duties off the port the proportion of fast blockading cruisers should be not less than two to one of the blockaded," and by using these figures with reference to the second great maritime Power an estimate of the number of ships required for this duty may be made.

The accompanying table shows the armoured ships of France arranged in classes on a basis of offensive power, speed, and age. At the bottom is the total number of each class, omitting ships not yet launched, with the proportion worked out giving the number of battle-ships that would be required to blockade them.

TABLE I.—*Battle-ships, 1st Class.*

Name.	Date of launch.	Displacement.	Number and size of heavy guns.			If carries torpedoes.	Speed on measured mile.	Coal radius.
		tons.	cm.	cm.		†		‡
Amiral Baudin	1883	11,121	3—37	12—14	6		15·1	3,080
Formidable.....	1885	11,121	3—37	12—14	6		15·0	
Amiral Duperré....	1879	10,924	4—34	14—14	4		14·33	2,850
Hoche.....	1886	10,481	2—34	2—27	5		17	4,000
Marceau	1887	10,432	4—34	17—14	4		16	2,900
Neptune	1887	10,432	4—34	17—14	5 ?		16·5	3,500
Courbet	1882	10,334	4—34	4—27	5		15·2	11
Dévastation	1879	10,334	4—34	4—27	5		15·2	3,100
Redoutable.....	1876	9,054	8—27	6—14	4		14·9	2,840
Caiman	1885	7,086	2—42	4—10	5 ?		15·0	
Indomptable.....	1883	7,086	2—42	4—10	5		15·0	2,680
Terrible	1881	7,086	2—42	4—10	4		15·0	
Requin	1885	7,086	2—42	4—10	5		15·0	
Brennus .....	..	10,826	} Building					
Magenta .....	..	10,432						
Tréhouart.....	..	10,480						
Total number..	13							

3 : 5 :: 13 = 22—No. required.

Battle-ships, 2nd Class.

		tons.	cm.	cm.	†		‡
Friedland.....	1873	8,956	8—27	8—14	4	13·2	
Richelieu	1873	8,956	6—27	5—24	4	13·2	3,700
Colbert	1875	8,759	8—27	2—24	4	14·5	2,112
Trident.....	1876	8,759	8—27	2—24	6	14·2	12
Marengo.....	1869	7,775	4—27	4—24	4	13·5	3,360
Suffren	1870	7,676	4—27	4—24	4	14·3	4,680
Océan	1868	7,578	4—27	4—24	4	13·7	9
Tonnerre.....	1875	5,609	2—27	..	No	14·1	2,100
Furieux	1883	5,609	2—34	..	2	13·9	1,500
Fulminant	1877	5,806	2—27	4—10	No	13·7	
Tempête	1876	4,822	2—27	..	No	11·7	1,150
Tonnant	1880	4,625	2—34	..	No	11·7	
Vengeur	1878	4,625	2—34	..	2	10·8	686
							9·7
Total number..	13						

3 : 5 :: 13 = 22—No. required.

TABLE I—continued.

Battle-ships, 3rd Class, and Armoured Cruisers.

Name.	Date of launch.	Displacement.	Number and size of heavy guns.		If carries torpedoes.	Speed on measured mile.	Coal radius.
		tons.	cm.	cm.	†		‡
Héroïne*.....	1863	5,905	8—24	3—19	No	13·0	
Savoie*.....	1864	5,905	8—24	3—19	No	12·25	
Revanche*.....	1865	5,708	8—24	3—19	No	13·25	
Onondaga*.....	1863	2,559	4—24	..	No	7·0	
Taureau*.....	1865	2,657	1—27	..	No	12·5	
Belier*.....	1870	3,543	2—24	..	No	12·5	
Tigre*.....	1871	3,543	2—24	..	No	12·5	
Bouledogue*.....	1872	3,444	2—24	..	No	12·0	
La Galissonnière...	1872	4,625	6—24	6—14	No	13·1	3,240
Victorieuse.....	1875	4,625	6—24	1—19	No	12·7	3,024
Triomphante.....	1877	4,625	6—24	1—19	4	12·9	
Turenne.....	1879	6,298	4—24	2—19	2	14·1	
Duguesclin.....	1883	6,102	4—24	1—19	Yes	14·5	3,300
Bayard.....	1880	5,905	4—24	2—19	No	14·5	2,118 12
Vauban.....	1882	5,905	4—24	1—19	2	14·3	
Thétis*.....	1867	3,543	6—19	4—14	No	12·0	
Montcalm*.....	1868	3,838	6—19	4—14	No		
4 canonnières cuirassées	..	1,613	1—27	3—10	No	13·0	1,800
4 canonnières cuirassées	..	1,033	1—24	..	Yes	13·0	850
Total number..	25						

25—8 = 17

4 : 5 :: 17 = 21—No. required,
or 17 second class battle-ships.

* Officially catalogued "sans valeur sérieuse."

† Figures in this column denote number of tubes.

‡ At 10 knots, or speed denoted by small figures under distance.

The numbers used in the calculation under the third column is obtained by omitting the eight canonnières cuirassées as not being battle-ships. Of the remainder, 10 are marked "*sans valeur sérieuse*," some of which might doubtless be patched up sufficiently for a fight in company with others, and 7 are armoured cruisers capable of taking a place in the line of battle, some of whom may be expected to be absent on foreign stations. Consequently a proportion of 4 to 3 is taken as being more in keeping with the requirements of this case, an alternative being given in an equal number of second class battle-ships.

The following is a summary of the ships required including those of the Reserve fleet, estimated at half the strength of the Channel Fleet. The number of cruisers and torpedo gun-vessels is estimated

in accordance with the proportion recommended by the above quoted Committee for the maintenance of an efficient inshore squadron. In the absence of any knowledge as to the number of cruisers to be blockaded, it is useless to give any estimate of the number required to blockade them. According as the strength of the enemy is abroad or at home, arrangements must be made as suitable. A telegraph cable-ship will be required to mend cut or broken cables, and to lay a cable to the base, or a position as near the scene of operations as possible. Colliers, store- and hospital-ships may be taken up on hire as required.

	Battle-ships.			Cruisers.			Gun-vessels.	Remarks.
	1st.	2nd.	3rd.	1st.	2nd.	3rd.		
Channel Fleet* }	22	22	21†	..	17	16	32	* Say half total force.
Mediterranean. }								† Or 17 second class.
Reserve.....	6	5	5	..	3	3	..	4 torpedo depôt ships.
Total	28	27	26	..	20	19	32	1 telegraph cable ship.

This is the force necessary to secure our shores from invasion and to take the initial steps for the protection of our trade and colonies against one maritime Power. It will probably be split into fleets and squadrons acting at different points, and the proportions between the classes may require readjustment in the different squadrons, but the sum totals are sufficient to allow for this.

To proceed with the defence of the more outlying parts of the station it may be remarked that in the great war at the beginning of the present century, in spite of a most numerous fleet in commission, we suffered heavy losses by the capture and destruction of our shipping in the English Channel. It is possible that such a dangerous route was preferable to the delays and dangers of the less known pilotage of the Scotch coasts, but whatever the reasons for its use were, it is obvious that with steam navigation the northern route would possess great advantages in the event of a war with France, and its general use may be expected by the ordinary sea-going shipping bound to or from the eastern ports, while the large liners and mail steamers, to whom time is the first consideration, will seek the western and Irish ports. The English Channel will, nevertheless, be required to be closely patrolled in order to bar the passage of a foe to the North Sea, and for the protection of the southern coast towns. Before considering this, however, it will be convenient to go farther afield and begin from the south of the station, working round the United Kingdom.

Gibraltar, the most southern British port on the Home station, is well situated as a base for ships cruising and patrolling to the west. The usual trade route to the south may be roughly said to be along

a line drawn from Cape Finisterre to St. Vincent, in the Cape Verd Islands, and it is proposed to protect this by a patrol of cruisers extending to the 20th parallel, the limit of the station, and a distance from Cape Finisterre of 1,520 miles. The anchorages in the Azores, Madeira, and neighbouring islands will require to be frequently searched to prevent an enemy establishing any store of supplies. Six second class cruisers should be sufficient for these purposes acting from Gibraltar.

From Queenstown there will be required a line of patrols stretching from Cape Clear to the westward, as far as 35° W. longitude, a distance of 1,000 miles, which will require one first class and three second class cruisers for protection.

Between Cape Clear and Cape Finisterre will pass a large portion of the shipping bound to the south and west, and in a line between the two there should be maintained a close patrol of cruisers, offering a barrier to the passage of hostile cruisers. A constant intercommunication should be kept up, and certain points should be known as rendezvous at which a ship may be expected every few hours, and whence information can be circulated to the other ships. The distance is 500 miles, and will require two first class cruisers and eight second class for the performance of these duties, to act from Queenstown.

Two ships cruising between Ireland and the Land's End will cover the Irish and Bristol Channels, and will raise the force acting from Queenstown to sixteen ships, to enable them to maintain their coal supply, and to take the place of ships in want of repair, another four, at the least, will be required, bringing the total up to twenty.

A cruiser, with six torpedo-boats, should be stationed at Milford Haven, to cruise across the south end of the Irish Channel. Another six torpedo-boats should be able to cover the South Wales ports and Bristol Channel.

In the event of a war with France we should find ourselves attacked by all sorts and conditions of craft large enough to carry a gun or two. Improvised men-of-war, under a commissioned Officer, to save the letter of the law, whose movements may be checked by a somewhat similar flotilla on our part. Tugs and large steam launches, armed with 64-prs. or 20-prs., and manned by Reserve men, commanded by men possessing local knowledge. A small premium to builders or owners would be an inexpensive plan of securing many such craft being built in accordance with requirements, while they would be of great assistance in supporting the more regular forces.

For the purposes of defence, the English Channel may be divided into four districts, the most western extending from a line between the Land's End and Ushant, to another line between Start Point and the Channel Islands; the next as far east as St. Alban's Head and Cape Barfleur; the third from this to Beachy Head and Dieppe; the fourth that part of the Channel east of this, as far as the Straits of Dover. These will naturally fall within the commands of the Portsmouth and Plymouth Commanders-in-Chief, the most eastern division being under a Commodore or senior Officer.

In the western district there will be required one second and two

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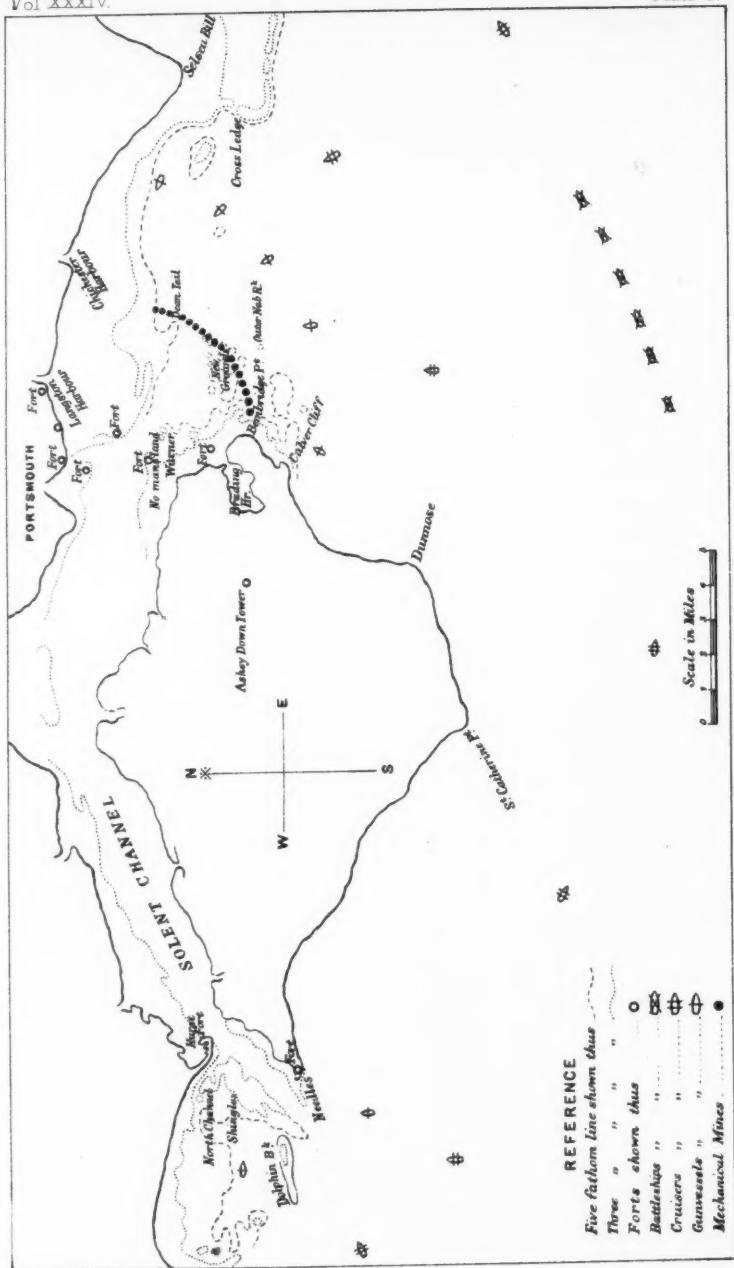
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third class cruisers, with a flotilla of twelve torpedo-boats, stationed at Falmouth, Plymouth, and Dartmouth.

In the next district a larger force will be required, for the Channel Islands lie within its limits. Portland will be the headquarters, whence will act the same force of cruisers as above, with 4 gun-vessels, 6 torpedo-boats, and some 8 or 10 armed tugs and launches.

In the Portsmouth district, 3 third class cruisers, 8 gun-vessels, 12 torpedo-boats, and 12 or 15 armed tugs and launches.

The Reserve fleet having been stationed in the eastern district, the cruisers allotted to it will be available for use therein, in addition to which there will be required 10 gun-vessels, 12 torpedo-boats, and 20 of the armed tugs or launches, all acting from Dover.

These squadrons should be kept constantly at sea, maintaining frequent communication with signal stations on shore.

Proceeding round the east coast, there will be wanted at Sheerness 2 third class cruisers, 2 gun-vessels, and 12 torpedo-boats. The cruisers will keep a look-out off the North Foreland, the remainder being stationed in the mouth of the Thames.

The want of a centrally situated harbour of refuge on the east coast, wherein shelter may be found and which could be entered at all times of the tide, has been frequently pointed out, Fife being the situation generally considered most convenient.

At Harwich or Yarmouth there should be a force of 6 torpedo-boats, and from this proposed harbour of refuge there should act 2 second class, 1 third class cruisers, with a flotilla of 8 or 10 torpedo-boats, to cover the east coast ports, 6 more boats being stationed at Leith or Dundee. Four gun-vessels will be required for the protection of the fishing fleets. These latter are generally held in international law to be free from liability to capture, an immunity which may be expected to last so long as they are efficiently protected.

A gun-vessel, or third class cruiser, will be required in the Orkney Islands.

On the western coasts of Scotland a cruiser should be stationed, to protect the fishing fleets and outlying islands, who could conveniently use Lough Foyle as a base. Five more cruisers will be required for this part of the coast, 3 cruising to the westward on the trade route, and 2 to cover the entrance to the Clyde and Irish Sea, in company with 6 torpedo-boats. One cruiser to be stationed on the west coast of Ireland. A flotilla of 6 torpedo-boats to be stationed in the Irish Sea, with headquarters at Holyhead.

This completes the round of the United Kingdom, the totals of the various classes of ships as above detailed standing thus: 3 first class, and 32 second class, 13 third class cruisers, 29 gun-vessels, 100 torpedo-boats, and some 30 or 40 armed tugs and launches.

The Mediterranean Station.

It is probable that the trade route to the East, through the Suez Canal, will, in the event of a war with a Mediterranean maritime Power, be abandoned in favour of that round the Cape. It is never-

theless necessary that our communications with Malta, Cyprus, and Egypt be kept open, and that an effectual barrier be opposed to an enemy attempting to force a passage to the east or west. For the accomplishing of these ends, the same tactics must be employed for the stationing of the fleet as have been adopted in the preceding chapter. That is, that bases must be obtained, the enemy's ships masked in their own ports by our fleet, while a force of cruisers patrols in the rear to secure the route as much as possible from interruption. To continue the parallel, a reserve fleet should be stationed at Malta or in the East; owing, however, to the facility with which the Canal might be temporarily blocked without material damage, such as by the sinking of a ship, also to the strength of Malta as a fortress, enabling it to hold out for a considerable period, such an increase may be considered as unnecessary.

The force required for the operation of masking will be a proportion, according to the strength of the enemy, of our battle-ships, as given in the previous chapter, with the requisite number of cruisers, &c., for the maintenance of the inshore squadrons.

Two second class cruisers, two third class cruisers, and four gun-vessels will be required to patrol the route from Gibraltar to Malta, a second and a third class cruiser to cruise between Cape de Gata and the opposite coast, watching the Straits, the same force between the Island of Sicily and Cape Bon, two more second class cruisers with two gun-vessels in the Levant, with headquarters at Cyprus. Torpedo-boats should be stationed at Gibraltar, Malta, Cyprus, and Port Said or Alexandria. Transports, colliers, and store-ships can be taken up from the mercantile marine as required; two torpedo depôt-ships will probably be required, but they have been already counted in the previous chapter, a telegraph cable-ship will be wanted to look after the cables on this and the Mid-Atlantic station. The force required in the Mediterranean, exclusive of those to be employed in blockading or masking, will then stand as follows:—6 second class cruisers, 4 third class cruisers, 6 gun-vessels, 18 torpedo-boats, and 1 cable-ship.

North America and West Indies.

The patrols established on the Home station for the protection of the trade crossing the North Atlantic must be continued here. Halifax is a convenient base for ships on the northern route, and is distant from the eastern limit of the station about 1,200 miles. Five cruisers will be required for this duty, of which two might be of the third class, another should be stationed with some torpedo-boats in the mouth of the St. Lawrence, and two gun-vessels in the fishery districts.

The route to the Gulf ports, Cuba, &c., and that lying along the American coast may be most conveniently protected from Bermuda. Three second class and two third class cruisers should be stationed here to patrol the route to the north-east and along the American coast as necessary, with a small flotilla of torpedo-boats to assist in the protection of Bermuda.

The West Indies were the scene of many a hard-fought struggle in the wars of the last century, their position within sudden striking distance of Europe and their wealth having always rendered them more open to attack than other colonies. These arguments hold good even more at the present time, with the certainty of steam transit and power of quick concentration, than in those days, and in view of which it behoves us to keep a strong force on this part of the station.

Jamaica and St. Lucia are the two principal bases on which our ships will rely whilst cruising amongst and protecting the islands, or operating against the enemy's possessions, and from the latter port patrolling along the trade route to the United Kingdom. These various duties will require a force of 3 first class cruisers, 4 second, and 4 third, 4 or 5 gun-vessels, and 12 torpedo-boats, making a total force for the station of 3 first, 10 second, 12 third class cruisers, 6 gun-vessels, and 18 torpedo-boats.

The Mid-Atlantic Station.

Within this station lies the narrowest part of the Atlantic—about 1,600 miles from shore to shore—an important line, across which lies the alternative route to the Suez Canal to half the world, and which should be held by a strong force of cruisers acting from Sierra Leone, the headquarters of the station.

This will require a squadron of 2 first class cruisers, 6 second, and 4 third, with 2 gun-vessels on the east coast of South America, searching the ports and anchorages.

St. Vincent, in the Cape Verd Islands, is a coaling port much used by steamers bound to or from the South American ports and the Cape and West Coast of Africa, and there is generally a large stock of coal lying there at present at the mercy of any unscrupulous cruiser. It is also a station in the line of telegraphic communication with the West African Settlements and the Cape. In the absence of any means to enforce respect for their neutrality, a close watch must be maintained on the entire group, to prevent an enemy obtaining shelter or supplies. To the eastward of the group lies the route for the mail steamers and large liners bound to the Cape, which should also be provided for. Three cruisers and a gun-vessel acting from Sierra Leone will be able to perform these duties and keep a look-out in advance.

Two gun-vessels will be required in the Bights and two cruisers to the south.

Sierra Leone is sufficiently covered by the above force to need any local force, but in the event of operations being undertaken against any settlement of the enemy's, six torpedo-boats would be useful.

There is great need of improvement in the facilities for coaling on this station, the supply at St. Helena is uncertain, and can only be delivered slowly in fine weather. Ascension is still worse. There being no sheltered anchorage on the coast from Sierra Leone to Fer-

nando Po, it is of great importance that better means should be found for coaling at Sierra Leone than at present exist there.

The force on this station, according to the above estimate, stands thus—2 first class, 9 second, and 6 third class cruisers, 5 gun-vessels, and 6 torpedo-boats; colliers and store-ships will be taken up and sent out loaded as required.

Cape of Good Hope Station.

With a strong force in the Mid-Atlantic and East Indies there is no necessity for maintaining a numerous squadron here. The Commander-in-Chief should be kept informed by telegraph as to the movements of any hostile ships likely to arrive within the limits of his command, and should keep his ships within easy reach of communication so as to be able to direct them as necessary. Four cruisers will be sufficient protection against such of the enemy's ships as succeed in breaking through the other lines, one being of the first class, two of the second, and one of the third.

East Indies Station.

At Suez there should be a sufficient force to hold the south end of the Canal, and arrangements made for temporarily blocking the Canal as a last resource. Coal-endurance not being of great importance in ships employed on this duty, it might be adequately performed by a few heavily-armed, light-draught gunboats, or two small armoured ships. Second class torpedo- or picket-boats should be stationed to patrol the Canal and lakes, and first class boats outside.

At Aden there should be stationed two second class cruisers and six torpedo-boats to close the Straits of Bab-el-Mandeb.

Mauritius lying near the trade route from the Cape to India will be the headquarters of the Southern Division consisting of 1 first class cruiser, 2 second, and 2 third, whose disposition will be arranged according to circumstances. Six torpedo-boats will be required and will be available in the event of any operations being undertaken. Two gun-vessels should be stationed on the East Coast of Africa to watch the harbours and perform the ordinary police duties.

At Colombo a squadron should be stationed to cover the trade route from attack from the east, and to search the anchorages in the islands in the Bay of Bengal. This will require 1 first class cruiser, 2 second, and 1 third.

Two more gun-vessels will be wanted in the Persian Gulf and on the Arabian coast, making a total force on the station of 2 first class cruisers, 6 second, and 3 third, 4 gun-vessels, 2 battle-ships or 6 gun-boats (at Suez), and 15 first class torpedo-boats. A telegraph cable-ship should also be available to repair cut or broken cables.

The China Station.

Several of the great Powers maintain squadrons on this station, those of France and Russia being in the greatest strength and possessing their own arsenals at Saigon and Vladivostok respectively. We possess a large local carrying trade along the coast of China, while that to Australia and Borneo is increasing, and a cruiser at large on either of these routes might do an incalculable amount of damage before she could be caught. Our squadron in these waters should, therefore, be of sufficient strength to maintain a blockade of the enemy's ports and to allow of cruisers being detached to patrol the routes and guard the narrow channels and passes to the south and west.

It appears possible, under existing conditions, that the defensive operation of blockade might be profitably converted into an offensive movement, an attack being made in conjunction with a military force and pushed right home. Such an operation would not involve any increase of the squadron required to maintain a blockade, beyond a few transports and ammunition ships, while its performance would secure a far greater freedom from attack throughout the Eastern Seas.

This squadron would be under the immediate direction of the Commander-in-Chief, and would consist of 2 first class cruisers, 6 others of the second and third classes, 6 fast gun-vessels, and a torpedo depôt-ship. Colliers may be obtained at Hong Kong, and will be required to accompany the squadron.

From Hong Kong to the north through the Formosa Channel as far as Japan there should be a patrol of two cruisers. To the south, guarding the route to Australia and the coasts of North Borneo, there should be two cruisers and a gun-vessel.

Singapore will be the headquarters of the Southern Division, consisting of 2 second class cruisers, 2 third, and 2 gun-vessels, who will be kept constantly cruising in the numerous straits and passages between the islands. Six torpedo-boats stationed here will be of great assistance in the performance of these duties. Twelve torpedo-boats at Hong Kong will be sufficient to admit of a flotilla detached to work with the fleet if required. The numbers in the various classes as above enumerated will then be as follows:—2 first class cruisers, 8 second, and 6 third, 9 gun-vessels, 1 torpedo depôt-ship, and 18 torpedo-boats, 1 telegraph cable-ship.

The Australian Station.

The remark about there being no need for a strong squadron at the Cape, made when dealing with that station, holds equally good here, and if, in addition to the squadron there mentioned as blocking the way through the Mid-Atlantic and East Indies stations, China be strongly held, the approaches to Australia may be considered fairly secure. To offset the chances of enemy's ships breaking through these lines, cruisers will be required at various points around the coasts, protecting the shipping and collecting information from

passing vessels, being assisted in the covering of the ports by torpedo-boats. They should be stationed as follows:—2 second class cruisers in King George's Sound, 1 with a flotilla of 6 torpedo-boats at Melbourne for the Bass Strait; 1 on the east coast with 6 torpedo-boats at the station headquarters, Sydney; 2 second class cruisers and 3 or 4 torpedo-boats at Port Darwin, to close the Torres Strait; a third class cruiser with 6 torpedo-boats in New Zealand; 1 second, 1 third class, and 2 gun-vessels to cruise amidst the numerous groups of islands, with headquarters at Fiji; lastly, a first class cruiser to act independently according to circumstances. Total—1 first, 7 second class, 2 third class cruisers, 2 gun-vessels, and 21 torpedo-boats.

The North Pacific.

With the Panama Canal yet uncut, there exists but little opening for an enemy to attack us on this station. There is a fishing industry on the coast of British Columbia, and a growing trade between Canada and China, while Vancouver, as the terminus of the Canadian Pacific Railroad, must be covered. Esquimaux will be the headquarters of the squadron, consisting of three cruisers and two gun-vessels.

The South America Station.

The Falkland Islands are our only settled possessions in this part of the world; they are well situated as a base for ships cruising off the Straits of Magellan and Cape Horn, but there are few facilities for coaling, and there is no telegraphic communication. There is a certain amount of shipping passing by this route to the Pacific coast, and a line of steamers from New Zealand round Cape Horn requiring protection, while provision must be made for preventing hostile cruisers getting into the Pacific Ocean by this route. For this purpose one first class cruiser and one second will be required on the east coast, a gun-vessel in the rivers, one second class cruiser and a gun-vessel at the Falkland Islands, and a third class cruiser on the west coast.

Total—1 first, 2 second, and 1 third class cruisers, 2 gun-vessels, and 1 or 2 colliers to accompany the ships as required.

Conclusion.

The following table shows the number of ships of the different classes on each station as above detailed, wherefrom can be obtained the total numbers of ships that will be required to be in commission, or to be immediately put in commission, on the outbreak of a war. It will be observed that the battle-ships have all been counted together, and that none have been stationed abroad. It has been assumed that our foe is an European Power, and under this assumption it is not considered necessary to so station them, considerations of possible

alliances may require it on such stations as China, where the fleets of the local Powers are of considerable strength.

No reference has been made to the use of mines in the defence of ports and rivers. Literally speaking, they are, of course, part of a maritime defence, and, as such, it may be thought that the arrangements should be under the control of the Naval Authorities; there are, however, valid objections to its being so.

Without discussing the amount of security afforded by the existence of a mine-field in comparison with the expense and number of men required to lay it and keep it in order, it may be said that the principle on which the fleet will act in defence of our ports will be that of keeping the enemy within his; and if this is accepted as the protection of our commerce demands, the retention of a naval force for the fixed defence of a port is so much loss of power to work out the principle practically. Secondly, the system of submarine mining in use in the Navy is much too rough and ready for adoption as a permanent defence. The elaboration of methods and the employment of highly skilled men will lead to the establishment of a special class, who will not be available for general service, and who would form as distinct a branch of the Navy as the artillery of the Army. On these grounds it is thought that it is undesirable to alter the existing arrangements, hence no attempt has been made to introduce the subject in detail.

Station.	Battle-ships.			Cruisers.			Gun-vessels.	Torpedo gun-vessels.	Torpedo-boats.	Torpedo depot-ships.	Telegraph cable-ships.	Remarks.
	1st.	2nd.	3rd.	1st.	2nd.	3rd.						
Battle and Reserve Fleets	28	27	26	..	20	19	..	32	..	4	1	And 40 tugs, launches, &c.
Home	3	32	13	29	..	100	..	..
Mediterranean	6	4	6	..	18	..	1	
North America and West Indies	3	10	12	6	..	18	1	1	
Mid-Atlantic	2	9	6	5	..	6			* Or 6 gunboats.
Cape of Good Hope	1	2	1						
East Indies	2*	2	6	3	4	..	15	..	1	
China	2	8	6	3	6	18	1		
Australia	1	7	2	2	..	21			
North Pacific	1	2	2					
South America	1	2	1	2					
Total	28	27	28	15	103	69	59	38	196	6	4	

Friday, February 28, 1890.

MAJOR-GENERAL F. G. RAVENHILL, Inspector-General of Remounts, in the Chair.

THE CASUALTIES AMONGST ARMY HORSES IN THE FIELD.

By Inspecting Veterinary Surgeon W. B. WALTERS, Army Veterinary Department.

THE subject which I have the honour to introduce to your notice is one of considerable interest to Officers of all branches of our land forces, and particularly to those who are immediately connected with the mounted portion of the Army; for not only is the heavy mortality which invariably occurs amongst the horses and other animals of an army in the field a question of serious moment, but scarcely of less importance, from a service point of view, are the numerous casualties of a more or less temporary character which are associated with every campaign, and which frequently cripple and reduce the strength of the fighting force to such an extent as to materially interfere with the progress of the military operations.

The efficiency of the mounted troops of an army is an important factor of success in war, and therefore it is obvious that any serious reduction in the strength of these arms must, of necessity, be a source of grave anxiety.

The experience gained by all departments of our Army since the Crimean days has been the means of vastly improving the condition of both the soldier and his horse, on service. Horses are now carefully inspected prior to embarkation, and only sound, serviceable animals are selected. The means of transporting mounted troops by sea have largely increased, and are greatly improved. All ships chartered by Government are thoroughly inspected by competent Officers, and are fitted with every modern appliance for the comfort and safe conveyance of the animals on board. Ventilation, sanitary arrangements, grooming, watering, feeding, the treatment of the sick, and the various other details attending the management of horses at sea are now thoroughly understood and efficiently carried out.

No less marked are the improved arrangements for the care of horses in camp. The exciting and predisposing causes of very many of those casualties which, in former years, used to fill our hospital lines, are now readily detected and should be as easily avoided.

Improvements in saddlery, line gear, forage and transport arrange-

ments, together with a properly organized veterinary service, have assisted to bring a very considerable number of these cases within our control. This fact being established we may reasonably expect a considerable reduction of the so-called preventable casualties in our future campaigns, but whether the knowledge we possess, or the means at our disposal, will materially affect the rate of mortality amongst horses in wars to come, is a question impossible to answer. It is more than likely that campaigns will be of shorter duration than heretofore, but, on the other hand, the introduction of magazine rifles of increased range, quick-firing machine-guns, modern artillery, and the probability of mounted troops being required to make greater exertions, tend to the supposition that the death-rate will be increased rather than diminished.

The question of our Army horse-supply has lately occupied the attention of able and competent authorities, and I believe I am correct in stating that, for the first time on record, arrangements have been made to establish—upon a complete and satisfactory basis—a reserve of seasoned horses, trained to saddle and harness, and in sufficient numbers to meet the requirements of an Army in the field. A raw remount is a poor substitute for a trained and seasoned troop horse, and therefore the establishment of this system cannot be too highly estimated.

The average mortality amongst the cavalry horses employed during the Crimean War has been estimated at 86 per cent. per annum. This percentage appears at first sight to be extremely high, but it must be remembered that, in addition to the losses caused by wounds and injuries received in action, the animals were subjected to privations of an unusually severe character. The suffering endured by both man and beast during the exceptional severity of the winter months is a matter of history. Hundreds of horses, weakened by exposure and other debilitating influences, sickened and died in the lines, while others fell victims to the inevitable consequences of unsuitable, and frequently insufficient, food. Glanders, farcy, and mange were rife, and scores of animals had to be destroyed.

When these facts are taken into consideration, the high rate of mortality amongst our cavalry horses in the Crimea can be readily understood.

During the Franco-Prussian War of 1870-71 upwards of 250,000 horses were employed with the German Army. Thirty-eight thousand horses were supplied as reinforcements, and of these 22,000 were provided by the Home Government, and 16,000 were obtained either by capture, or by requisition on France. The losses among these animals were, according to the official account, as follows:—

Killed or died of wounds	7,325
Wounded	5,547
Missing	1,723

Total..... 14,595

The reserve of horses for the Russian Army during the war of

1877 against the Turks was calculated at 10 per cent. only of the number in the field.

I regret that I have been unable to obtain reliable statistics as to the casualties which occurred in this campaign, but it is obvious that the requirements for remounting must have very considerably exceeded the estimate.

In the spring of 1879, 2,323 horses embarked with the British troops proceeding to South Africa to take part in the Zulu campaign. Of these, 82 died, and 3 were destroyed on the voyage, leaving a total of 2,241 landed at Durban. In addition to these animals, a battery of Royal Artillery was already in the country, and about 4,250 colonial horses were purchased for mounting local corps, and for various other purposes.

The casualties among the English horses from the date of debarkation to the 30th September, 1879—a period of about six months—were as follows:—

Admitted to hospital.....	1,584
Cured	1,117
Relieved	36
Incurable.....	2
Died.....	257
Destroyed	46
Remaining under treatment.....	126
Total percentage of all casualties	71·0
" " died and destroyed	13·5

The casualties amongst the colonial horses from the 1st October, 1878, to the 8th October, 1879, were:—

Admitted to hospital.....	3,369
Cured	2,209
Relieved	279
Incurable.....	1
Died.....	446
Destroyed	130
Remaining under treatment.....	284
Total percentage of all casualties	79·0
" " died and destroyed	14·0

For the sake of brevity and convenience I have grouped the various classes of diseases and injuries as follows:—

	English horses.	Colonial horses.
Fevers, lung diseases, &c	152	761
Diseases of other internal organs.....	543	214
Specific diseases.....	135	628
Diseases of the skin	39	415
" " eye	14	24
" " foot	84	73
Contusions, wounds, and injuries, various ..	590	1249

Under the head of "specific diseases," 5 English and 66 colonial horses died of, or had to be destroyed for, glanders and farcy; 26 English and 398 colonial horses were treated for mange; 34 English and 67 colonial horses sustained gunshot wounds, of which 17 of the former and 24 of the latter died, or were destroyed; 253 English and 488 colonial horses were admitted to hospital for saddlery, harness, and heel-rope galls, and 45 English and 197 colonial horses were attacked by that fatal disease, peculiar to South Africa, known as "horse-sickness." Of these animals 205 died and one was destroyed.

Cases of ordinary lameness were remarkably few, while, on the other hand, casualties arising from contusions, wounds, and other injuries were very numerous. Two horses were drowned, 3 died from snake-bite, and 19 were poisoned by a species of wild tulip plant, called by the Dutch "tulp"; 11 of these died and 8 recovered.

No casualties from the attacks of the Tsetse fly occurred during the war. At one time this insect caused great losses to farmers and cattle breeders; but of late years it seems to have disappeared altogether from the districts it once infested.

The above statistics suggest two features of interest:—

1. The prevalence of sore backs and other galls.
2. The mortality caused by the so-called "horse-sickness."

It will be noticed that the English horses, although more heavily weighted, suffered considerably less in proportion from sore backs than those of the irregular corps. This was probably due, in a great measure, to the use of folded blankets under the saddles, as well as to the care and attention bestowed on the animals by experienced cavalry Officers.

In the colonial corps blankets were not carried, owing to the supposition that their value would be insufficient to compensate for the extra weight imposed. The saddlery issued to these troops was purchased in the colony, and proved to be ill-fitting and of inferior quality. The saddles constantly required repairing, but the paucity of saddlers and want of material rendered this, at all times, a difficult matter, and frequently it was impossible to keep them in a serviceable condition. Hence the number and severity of sore backs amongst the irregular cavalry in Zululand.

As regards the mortality from "horse-sickness," it has already been remarked that this disease is peculiar to South Africa, and is very fatal. It is specific, miasmatic, and septic in its nature, and is due to the presence of a micro-organism very similar in appearance to the germ of anthrax. The symptoms also of the two affections are somewhat alike, but late experiments have proved that the diseases are not identical.

"Horse-sickness" occurs as an enzootic in the spring and summer months, and generally attacks horses on low-lying ground or near the marshy banks of rivers. It is also prevalent on the sea coast, and is accelerated by those conditions which tend to produce debility and depression of the vital powers.

In the summer of 1882, 5,080 horses embarked with the troops proceeding on active service to Egypt.

Forty-seven of these animals died on the voyage, and the remainder were landed in good condition.

The following casualties occurred from the date of debarkation to the 30th November, 1882 :—

Admitted to hospital.....	2,567
Cured.....	1,227
Relieved.....	338
Died.....	408
Destroyed.....	104
Remaining under treatment.....	410
Percentage of all casualties.....	50·5
„ died and destroyed	11·3

The majority of admissions (1,313) were, as usual, for surgical diseases, wounds, and injuries, of which 82 were gunshot wounds; 35 of these animals died, or were destroyed, and the rest recovered.

Eight hundred and seventy-six cases of saddle, harness, and rope galls occurred; 4 horses were destroyed for glanders and farcy; 282 were admitted for exhaustion and debility; 170 for diseases of the respiratory organs; and 477 for malarial fever.

Very few casualties occurred amongst other classes of diseases; lameness was rare, and no cases of mange were recorded.

At one period of the campaign the 7th Dragoon Guards had 213 horses on the sick list, the great majority of cases being sore backs, heel-rope galls, and debility.

Out of 518 horses landed in Egypt, this regiment lost 114 from various causes up to the 30th November.

The principal points of interest appear to be :—

1. The excessive number of sore backs and other galls.
2. The outbreak of a specific malarial fever.

It will be remarked that although this campaign was of shorter duration than the Zulu war, the number of sore backs amongst the English horses in Egypt was considerably greater in proportion.

The majority occurred amongst the cavalry, and many cases were caused by the surcingles, which were used in the lines to keep the numnahs in their places, in order to protect the horses' backs from the effects of the sun.

For this purpose it was necessary to buckle them somewhat tightly, and as they were without pads, the pressure upon the spines, especially of those horses which were low in condition, produced abrasions and sores of greater or less severity.

Very many other cases were doubtless caused by direct saddle pressure, as the folded blanket was not used under the saddle during the operations.

The outbreak of malarial fever appears to have been due to the impure state of the ground on which the cavalry and artillery horses were picketed at Abassieh. This ground had been used for camping

purposes by pilgrims for ages, and the exhalations arising from the soil, together with the miasma evolved from the flooded land in the neighbourhood, was inhaled by animals whose exhausted condition and loss of vital force predisposed them to contract disease.

The horses employed with the Nile Expeditionary Force were comparatively few in number, and consisted principally of the 19th Hussars—Arab ponies—under the command of the late Colonel Barrow.

It is worthy of notice that, notwithstanding the marvellous amount of work performed by these hardy little animals, casualties amongst them were very few.

The fatal cases from 1st November, 1884, to 5th July, 1885, were 71 in number, including 20 killed in action and 27 destroyed for wounds and injuries. Only one case of sore back was recorded.

The Suakim Expeditionary Force which embarked in the spring of 1885 included 2,530 horses of all arms—British, Indian, and Australian. Nineteen deaths occurred during the voyage.

In addition to these animals, a considerable number of Egyptian and Syrian horses were purchased for the use of the mounted infantry.

The casualties from all causes from February to 31st May, 1885, were:—

Admitted to hospital	657
Cured.....	334
Relieved.....	186
Incurable	3
Died	40
Destroyed	34
Remaining.....	53
Total percentage of casualties	26.0
“ “ died and destroyed..	3.0

The deaths include 25 horses killed in action or reported “missing.” Seven horses were destroyed for glanders, 50 cases of exhaustion occurred, and 468 were treated for diseases, wounds, and injuries not classified. Amongst these were a very considerable number of sore backs; no less than 68 cases in the 5th Lancers and 23 in the 20th Hussars occurring during the month of April. Saddlery galls were also numerous amongst the horses of the Indian cavalry.

In my official report on the campaign I find the following remarks on this subject:—

“I consider that many of these sore backs might have been prevented had the folded blanket been used instead of the numnah, which was not sufficient to prevent saddle pressure in those instances where muscular wasting occurred from loss of condition.”

Bilious and climatic fevers were prevalent, but not to such an extent as to call for special remark.

Although the military operations were of short duration, the climate was a severe trial to English horses, already fatigued by the voyage,

and with their winter coats only partially shed; and had the campaign been prolonged through the summer months, the sickness and mortality amongst these animals would probably have been very considerable. The artillery and other draught horses kept their condition fairly well, and were comparatively free from sickness, but, except in two or three instances, they were never subjected to severe exertion, and, being near the base, were always within reach of suitable food, shelter from the sun for their sick, and good water. The cavalry, on the other hand, were, more or less, continually on the move, especially the detachments at the advanced posts, and the horses lost condition rapidly, many of them becoming very emaciated. The Egyptian and Syrian horses endured the hardships and climatic influences to which they were exposed remarkably well, and those of the Indian cavalry also kept in fairly good condition, although they were somewhat "fine drawn" at the end of the campaign.

I have not thought it necessary to refer to the casualties amongst the horses of the Transvaal and Bechuanaland expeditions, as they were similar in character and extent to those which occurred during the Zulu war, and possess no particular feature requiring special comment.

Having briefly considered what may be termed the historical, or statistical, portion of this subject, we shall now proceed to inquire into the predisposing and exciting causes of some of the principal casualties met with on war service, and also as to the best means of prevention in those cases which are within our control.

I have not attempted to allude to the medical or surgical features of any particular disease or injury, because such a course would obviously be out of place in a paper of this description, even if it were possible to do so in the limited time at our disposal. I have also endeavoured to avoid all matters of a technical nature, and to dwell only upon those points which, if they are considered worthy of discussion, are most likely to elicit opinions of importance and suggestions of practical value.

The casualties prevalent amongst army horses in the field are frequently divided into two divisions, "preventable and non-preventable;" but these terms are scarcely applicable in a literal sense, and are often misleading and frequently incorrect. A casualty may, under certain conditions, be correctly described as "preventable," while, under other circumstances, a similar case will undoubtedly belong to the opposite class.

Again, an outbreak of sickness may occur amongst the horses of an army, and although the original cause may be distinctly non-preventable, yet the range and extent of the malady may be so far under our control that the application of scientific knowledge, practical experience, and common sense will speedily arrest its progress, and eventually stamp it out.

I think, therefore, the best and simplest plan will be to consider the subject under the following groups or classes.

Specific, Malarial, and Climatic Fevers.

The outbreaks of "horse-sickness" in South Africa, and "malarial fever" in Egypt, to which I have already referred, will serve to illustrate this particular class.

Climatic fevers are, more or less, prevalent in all countries of a tropical or semi-tropical character, and their evolution is invariably accelerated by those conditions which tend to produce debility, or depression of the vital powers; consequently, if horses are massed in considerable numbers on impure or low-lying ground near marshy or flooded land, while suffering from such predisposing influences as the result of over-work, insufficient or unsuitable food, &c., it is highly probable that an outbreak of some form of malarial sickness will occur amongst them.

The preventive measures to adopt are indicated by the cause.

If the exigencies of the military operations will admit of it, all such localities, especially for camps of position, should be avoided, as well as ground from which scrub, trees, or other vegetable growth have lately been cleared. When practicable, camps should be pitched at least 50 feet above the level of running water. Frequently, for tactical and strategical reasons, it is absolutely necessary to picket the horses of mounted troops on ground in the neighbourhood of swamps or marshes, in which case the site selected should, if possible, be to windward of the prevailing breezes.

The above remarks, with reference to the selection of camping ground, are equally applicable to cases where malarial disease has already made its appearance. Affections of this nature are often effectually suppressed by prompt change of locality.

Contagious Diseases.

Glanders, farcy, and mange are the only diseases of this class to which I need refer. The two former are identical affections, differing only in their local manifestations. Glanders has from time immemorial been the scourge of armies in the field, and in former times the losses from this fatal disease were enormous.

I have already remarked upon the prevalence of glanders in the Crimea, and have also referred to its outbreak in our more recent campaigns. In the latter, however, the cases were comparatively few in number, and, owing to the precautions taken, the malady was always promptly suppressed.

Writing on the prevalence of glanders in the German Army, during the Franco-Prussian War, Dr. Fleming remarks, in his work on "Veterinary Sanitary Science and Police," that "the magnificent German cavalry took the field after every care had been exercised that no glandered horses should be in the ranks, and yet, at the end of the campaign, every regiment, it is reported, was more or less infected."

The same writer also refers to the presence of glanders during the

Franco-Italian struggle with Austria, and to the havoc it created amongst the Tartar ponies during the war in North China.

Mange is a contagious skin affection, due to the presence of a parasite, and used to be one of the most troublesome and formidable maladies with which the military Veterinary Surgeon had to contend during a campaign.

The chief factors which favour the development and extension of this disease are exposure to cold, tempestuous weather, exhaustion, debility caused by fatigue, insufficient food, and the numerous hardships and privations incidental to a prolonged campaign.

Not only were many hundreds of horses affected by mange during the Crimean War, but the mortality amongst them was very great.

Beyond the cases which occurred during the Zulu War, our army horses have been singularly free from mange in recent campaigns.

I refrain from alluding to the measures to be adopted for the prevention and suppression of these and other contagious diseases, as this is a question more particularly for the Army Veterinary Department. All I need say is that in future wars everything that experience can suggest, or science indicate, will be done by those who are responsible for the efficiency of our troop horses, to prevent a repetition of the calamities that occurred in the Crimea.

Dietetic Diseases.

Casualties arising from diseases of the digestive organs are oftentimes numerous on active service, and are caused chiefly by irregular feeding and watering, insufficient, indifferent, or improper food, and bad water.

During the Zulu War many cases of intestinal disease occurred from the above causes, especially amongst the English horses, which were unaccustomed to the coarse, and often indigestible and innutritious, grass met with in some localities.

It is recorded that during the Franco-Russian War of 1812 the French cavalry lost upwards of 1,000 horses in a single night from eating too freely of green clover.

All sudden changes of diet should be avoided, and when it is absolutely necessary to issue forage to which the horses have hitherto been unaccustomed, such food should always be given sparingly at first, and gradually increased. This rule particularly applies to barley, maize, beans, and peas. In a grass country the same precautions should be observed with regard to grazing.

It is essential that horses should be allowed to drink freely and as often as they are so inclined, provided that the water is of good quality; but all stagnant water, fouled by decomposing animal or vegetable matter, should be avoided.

In these days of portable compressed forage and improved means of transport it is probable that in our future campaigns there will be a marked diminution of casualties from dietetic diseases.

Exhaustion.

Casualties resulting from exhaustion are frequent on service, and are due to causes over which we have little or no control, such as rapid or forced marches, extended operations over hilly, mountainous, or boggy ground, or through deep sand, and occasionally to the physical unfitness of individual animals. This latter cause is, however, comparatively rare, owing to the care exercised in the selection of horses prior to embarkation.

During the march from Tel-el-Kebir to Cairo in 1882 many horses suffered severely from exhaustion, especially those belonging to the Commissariat and Transport Corps. These animals had to draw heavily-laden carts through the deep sand of the desert, and it was doubtful at one time if they could reach Cairo. The Veterinary Officer in charge remarks: "Several horses died from utter exhaustion, and pulmonary congestion, caused by the excessive nature of the work, heat, want of food, and the many hardships they endured. On arriving at Gazireh, out of 140 transport horses, 75 had to be struck off duty, nearly all for debility and lung affections. Some of these animals were so weak that they could not walk to the watering place, and several more deaths occurred."

Diseases of the Lungs and Air Passages.

Casualties from these causes depend in a great measure upon the nature of the climate, and the conditions under which the animals are placed. Extremes of temperature, and exposure to cold and inclement weather are the chief factors in the production of these affections.

A congested condition of the lungs is frequently caused by severe exertion, especially during hot, close weather; but casualties from diseases of this class have not been remarkable, either as regards number or severity, in our recent campaigns.

Lameness.

Owing to the fact that none but serviceably sound horses are allowed to proceed on service, cases of ordinary lameness in the field are, as a rule, remarkably rare.

Wounds and Injuries received in Action.

Gunshot and other wounds received in action are altogether beyond our control, and depend in character and extent upon the nature and conditions of the military operations. Further remarks upon this class are unnecessary.

Surgical Diseases and Accidents.

Casualties of this description are perhaps more numerous amongst

the horses of an army in the field than those of any other class. They include the various kinds of wounds, contusions, fractures, sprains, heel-rope galls, &c. I have purposely omitted saddlery and harness galls from this class, as the subject of sore backs is one of the most important of all with which we have to deal, and therefore deserves special consideration. Wounds and injuries occurring in the lines are, as a rule, caused by rope galls, or by kicks from other horses, and vary in severity from the ordinary contusion to the fracture of a limb. Very many of these cases are of a temporary character, simple enough in themselves, and easily cured; but frequently they are so numerous as to seriously menace the efficiency of the mounted troops. Hence, prevention becomes a question of importance, and, in considering the best means to adopt in order to ensure a diminution of these injuries, it will be necessary to allude briefly to the subject of

Picketing.

Within the last few years several systems of picketing have been advocated, and have been tried with more or less success, but I am not aware that any plan has hitherto been so satisfactory as the ordinary ground line, with head- and heel-ropes. Assuming that this arrangement affords the best means of securing troop horses in camp, the chief points for consideration are the precautionary measures necessary in order to protect the animals as far as possible from injury.

The ground rope, whether entire or interrupted, should be made of the best material so as to combine lightness with strength and durability. It should be well stretched, and firmly pegged down, the pegs being driven flush with the ground in order to prevent injury to the horses when lying down. The ordinary wooden peg is liable to break, and is often a source of trouble on service, and might, with advantage, be superseded by a light iron peg with a solid head, and riveted collar for the attachment of a link of chain. Pegs of this description were used with complete success in South Africa, and, although exception may be taken to the extra weight, the increase would be inconsiderable, and would be fully compensated for by the superiority of the iron peg, especially for standing camps.

When picket-pegs cannot be used, owing to the light, sandy nature of the soil, a buried stone, brick, or log of wood, well rammed down, will answer the purpose.

Heel-ropes are necessary, at all events during the earlier part of a campaign, and it is questionable whether it is prudent to dispense with them altogether at any time. Certainly, horses soon become used to the picket lines, and are naturally quieter and more tractable after a period of constant hard work. Many experienced Officers consider that heel-ropes may be discarded with safety after a time, and we have instances on record in support of this view. During the Boer War of 1881 the Inniskilling Dragoons and mounted Engineers very soon discontinued the use of heel-ropes, and with

satisfactory results. Of course, no horse known to be vicious would be left in the lines unsecured. Such animals should, under any circumstances, be picketed by themselves. There are, however, many horses in the ranks not absolutely vicious, but with an inclination to kick on the slightest provocation, and unless these animals are properly secured by the heels, they are very likely to inflict serious injuries on their neighbours; especially after a few days of rest and inaction.

If heel-ropes are properly adjusted, they cause little or no inconvenience, while as a safeguard against casualties their value is unquestionable.

I do not, of course, contend that horses thus secured are incapable of inflicting injury, but I know from experience that, under such conditions, casualties will be considerably fewer in number, and much less severe. As all undue weight must be avoided, it is necessary that heel-ropes should be made of the best material, and in this respect those which now form part of our equipment might easily be improved upon. Many a serious casualty has been caused by the breakage of a heel-rope. The shackle should be carefully fitted, and placed *below* instead of above the fetlock, except in those cases where the presence of cracked heels or abrasions renders it necessary to alter the position.

Referring to the subject of heel-ropes, the Veterinary Officer attached to the 7th Dragoon Guards in Egypt writes: "The cases of galled heels would not have been nearly so numerous if the heel-ropes supplied at Cairo had been of better quality, but they were so thin that they easily broke, and the horses got their heels over the head ropes. Up to the 23rd of October, when these inferior heel-ropes were issued, none had been carried by the regiment, and therefore no means existed of preventing the animals from turning round and getting their heels over the picket line and head-ropes of neighbouring horses. Numerous and severe galls were thus caused, rendering the animals quite unfit for duty for weeks.

"The Royal Artillery from India had their heel-ropes with them throughout the campaign, and they, therefore, had fewer cases of heel gall than the other mounted troops which came under my notice. It is most essential that heel-ropes for every horse should be carried, as nothing renders a horse so utterly useless for duty as a bad heel gall."

The fitting of the head- and heel-ropes should be uniform, and so arranged as to allow the animals as much freedom as is consistent with security. If the head-rope be too long, injuries will probably be caused by the horse's forefeet becoming entangled, and also from bites.

Uniformity should also be observed in securing the head-ropes to the picket line, which should be done by a simple *clove hitch*. By this method, lateral slipping is prevented, the knot is perfectly secure, and can be easily and quickly untied even during wet weather.

The head collars should be carefully and securely fitted, so that they cannot be slipped.

It is advisable that as much space as the arrangements of the camp will admit of should be allowed between each horse on the picket lines.

Sore Backs.

Casualties resulting from saddlery and harness galls are perhaps the most important of any with which we have to deal; not only on account of their extreme frequency, but also because the majority of the cases which occur on service can, and ought to be, prevented. When we consider the vast number of horses which were rendered temporarily useless from injuries of this description during the brief military operations in Egypt, and think of what the consequences might have been had the campaign been indefinitely prolonged; it must be admitted that the subject of sore backs demands the earnest and immediate attention of those who are responsible for the efficiency of an army in the field.

I regret that time will not permit me to do more than briefly refer to some of the principal points in connection with the causes and prevention of sore backs; but the subject is one of such magnitude that it is impossible to deal with it in complete detail in my present paper.

Referring to the severity of the cases of sore back amongst the horses of our cavalry in Egypt, the Veterinary Officer attached to the 7th Dragoon Guards writes:—

"The sore backs and fistulous withers were the worst I have ever seen, and several horses were destroyed from these causes, as it was impossible to cure them. Some of the cases began early in the campaign, but it was impossible to treat them effectually, as the horses could not be relieved from duty."

All military Officers are aware that the exigencies of war service sometimes demand extraordinary exertions on the part of cavalry, and that there are occasions when it is absolutely necessary that every available horse should be in the ranks. A sore back is no excuse. It is in instances of this sort that practical experience and a thorough knowledge of the art of saddle-fitting are of inestimable value. By the exercise of a little mechanical ingenuity, many horses with galled backs have been enabled to carry their riders on an emergency without undue suffering to the animals, or adding to the severity of the injuries.

Causes and Prevention of Sore Backs.

For the sake of convenience, and in order to avoid repetition, it is desirable that we should consider the two subjects, "*Cause and Prevention*," under one head.

The principal causes of sore backs are:—

1. The faulty position of the saddle.
2. The defective condition of the saddlery.
3. The accidental presence of foreign matters under the numnah.
4. Careless saddling.

5. Careless riding.

6. The weight and distribution of the accoutrements.

The Saddle.—As you are aware, the present cavalry saddle was adopted on the recommendation of an influential Committee, after long and mature deliberation, but whether it answers all the requirements of the Service, or whether it might be improved upon, are questions scarcely within the scope of this paper, although they are well worthy of consideration. We have merely to deal with the saddle as it is; to inquire into the conditions which render it a source of injury to horses' backs; and to suggest the adoption of such preventive measures as are best calculated to meet each particular case.

Sore backs may be divided into injuries to the withers and injuries to the back proper.

Injuries to the withers occur from the front arch of the saddle or the edge of the felt numnah pressing upon the part, and are caused either by the arch being unduly wide and allowing the saddle to rest on the top of the withers, or by its being too narrow and pinching the sides. In either case it is obvious that the saddle does not fit, and should be changed; but if this is impossible, the evil may be remedied by the use of a blanket, folded the requisite thickness, and in such a manner as to relieve the parts from pressure.

Injuries to the back proper may be caused by irritation produced by badly-stuffed panels, damaged numnahs, ill-fitting side-boards, careless riding, pressure from the valise kit, long and continuous saddle pressure, removing the saddle too soon after the man has dismounted, and from such accidental causes as breakage of the tree or leather work.

The remedies to a certain extent suggest themselves, but there are several important points worthy of notice.

A saddle which fits a horse in "barrack yard condition" soon ceases to do so on active service in the field, for the simple reason that hard work and short rations cause loss of flesh, and this muscle-wasting materially alters the conformation of the back; consequently, the saddle becomes a misfit, and the protection afforded by the numnah is totally insufficient to prevent its galling the back or withers. Here, again, the folded blanket is invaluable, but if this is not available, a second numnah may serve the purpose. Re-stuffing the panels is a remedy which must not be overlooked; but this is not always possible on service, and in any case can only be temporary. Plaited straw mats have been recommended for this purpose, and when properly "chambered" have been advocated for the protection of galls. I am, however, unable to say anything as regards their practical value from personal experience.

Chambering the panels is often resorted to, in order to relieve a gall from saddle pressure. This is done by removing a portion of the stuffing from that part of the panel which is in contact with the wound, and cutting a corresponding hole in the numnah. My experience of this plan has been the reverse of satisfactory, and I do not recommend it as a remedy.

Injuries from badly-fitting side-boards occur principally from two causes. A straight-backed horse requires straight side-boards, and if these are unduly curved the pressure will be directed to one point—the centre—and the saddle will have a tendency to rock. If, on the other hand, straight side-boards are fitted to a hollow-backed horse, undue pressure will be caused by the front points and rear fans, and the saddle will oscillate. In neither case can an even bearing be obtained, and a sore back is a certainty.

A change of saddle is the only proper remedy, but if this be not possible the folded blanket may be used with advantage.

Shifting of the saddle is nearly always in a forward direction, and may arise from either of the above causes, or from defective conformation, such as a shallow chest, low fore-hand, high loins, and excessively arched ribs.

It is a difficult matter to keep the regulation saddle in its place on a very short-backed horse, because the rear fans project so far back upon the loins that the saddle is pushed forward by the action of the muscles, and the front points of the side-boards will interfere with the free play of the shoulder blades. The remedy is to cut off the points of the side-boards, front and rear, and to screw on curved iron plates. This plan will probably succeed in cases of saddle shifting from other causes.

A broad Cape or Australian girth, made of plaited raw hide, may be substituted for the ordinary girth with advantage.

Galls from frayed or chafed numnahs, or from accumulations of sand, dirt, and dried perspiratory matter are common enough on service, and can only be avoided by the exercise of care and vigilance on the part of Officers, non-commissioned officers, and men, and by a systematic course of saddlery and back inspections.

The prevention of casualties from careless saddling and careless riding is also to a great extent in the hands of the regimental authorities.

The weight and distribution of the accoutrements are points which I approach with a certain degree of diffidence, because I am aware that the subject of saddle equipment has been thoroughly and exhaustively considered from time to time by experienced cavalry Officers, and has lately been settled on the lines laid down by the Saddlery Committee. I venture to submit, however, that the weight imposed upon the troop horse, in marching order, by the miscellaneous articles comprising the soldier's kit, is a powerful factor in the production of sore backs, and that if all superfluous weight could be otherwise carried—say, in light troop carts—the number of non-effective horses on service would be considerably reduced.

As regards the distribution of the saddle equipment, I have had the privilege of inspecting from time to time the excellent and practical arrangement for carrying the kit devised by Lieutenant-Colonel Hutton, for the use of the mounted infantry at Aldershot, and have often thought that if a similar system could be adopted by cavalry regiments it would be a great boon both to the soldier and his horse. The principal weight being carried in detachable saddle-bags, which

hang below, and in a line with the centre of gravity, the fore-hand and loins of the horse are relieved of the mass of dead weight at present carried in front and in rear by the cavalry trooper.

Saddle and Saddle-bags proposed by Lieut.-Colonel Hutton for use by Mounted Infantry, and troops mounted on small horses.

FIG. 1.

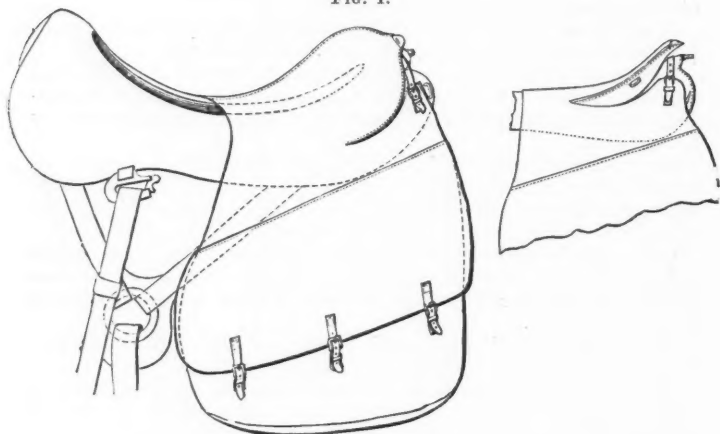
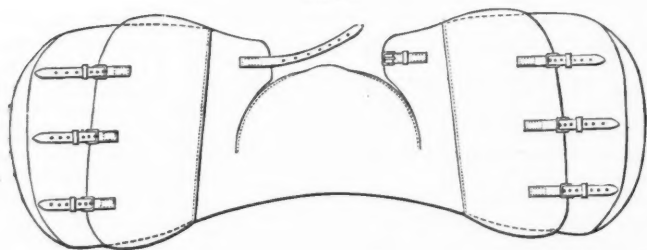


FIG. 2.



As Colonel Hutton remarks in his paper on Mounted Infantry, "Fatigue is saved to the soldier and the minimum of inconvenience is caused to the horse."

I trust that I may not be deemed out of order in referring to this subject, but I think it is one well worthy of consideration. The saddle is of the American pattern, and rests upon the man's neatly-folded blanket.

Girth galls are caused by the saddle shifting forwards, by the girths becoming stiff and hard from perspiration, and by careless saddling.

The remedy is to change or refit the saddle, and, if possible, to use a split or raw hide girth.

Crupper galls are caused by an unduly tight crupper. This article of saddle furniture is at all times a useless encumbrance, and might advantageously be dispensed with on service.

The same remarks will apply to the breastplate.

Carabine-bucket and sword galls are frequently met with on service, but these injuries are never, as a rule, severe, and can be remedied by slightly altering the position of the weapons.

Surcingle galls are often very numerous, and sometimes severe. The cause has already been alluded to in my remarks on the cases of sore back in Egypt. A very simple and effective remedy is to place a pad of hay or grass on each side of the spine, under the surcingle, if ordinary stuffed pads are not available. A surcingle should never be knotted to reduce its length.

Collar and harness galls are neither so frequent nor so severe as those caused by the saddle, and do not require special mention. If a collar becomes too large as the result of a horse falling off in condition, the best remedy is to pad it with strips of numnah felt. The same method can be adopted to save a gall from pressure. *Chambering* the collar for this purpose should be avoided, as it is practically useless.

Blankets.—From what has already been said it will be concluded that I am a strong advocate for the folded blanket under the saddle, on service. Much difference of opinion exists on this point, and the following objections to the blanket have been advanced :—

1. The trouble and difficulty in folding it in the dark.
2. Its tendency to slip from under the saddle.
3. Careless and uneven folding, causing sore backs.
4. The extra weight.
5. Its liability to become saturated with wet, and covered with mud.

Experience has proved that the first three objections are absolutely untenable. If a blanket is properly folded it will retain its place under the saddle, and soldiers can be taught in a few lessons to do this with ease, rapidity, and without wrinkling it, even in the dark.

A blanket sufficiently stout in substance is certainly somewhat heavier than a numnah, but I consider that the slightly additional weight is more than compensated for by its many advantages. As regards the fifth objection, Inspecting Veterinary Surgeon Lambert, writing on the subject of sore backs in South Africa, says: "Another objection, and, I think, the only one that requires seriously to be met, is that the blanket, when on the horse during the night, may be rolled on if he is down, and that it may, if the weather be wet, thus be saturated or partly covered with mud. This looks a formidable business, but it is only so in appearance. The blanket can rarely get so muddy as all that: the number of wet days is really few, and a blanket does not take so long to dry as is supposed." Referring to the many advantages of the blanket, this Officer continues: "We found, in the 17th Lancers during the Zulu campaign,

the following to be the advantages of the blanket. It furnished a much-wanted warm covering for the horse at night. Horses often fall away in condition very rapidly at first during a campaign, so much so that the saddles which fit them well in barracks will become much too large, and consequently a prolific source of sore backs. A numnah has very little effect in compensating for this reduction of condition; but the blanket I recommend can be doubled as often as necessary, and so the saddle by this means can be made to fit. . . . The men of the 17th Lancers were constantly obliged to fold their blankets, and saddle in the dark; but I do not remember our attributing any 'backs' to wrinkling or bad folding. . . . If the nights are cold, I consider a good large blanket equivalent to an extra feed of oats per diem in saving expenditure of animal heat, and, in addition, there is the gain in comfort to the horse. . . . I recall to mind many instances where, a sore back having occurred with a numnah, a blanket was ordered, and the injury gradually got well without the horse's work being stopped."

The above remarks are the outcome of actual personal experience in the field, and go far to substantiate what has already been said with reference to the superiority of the blanket for active service. Not only can the blanket be folded in various ways to suit nearly all conditions of backs and saddles, but by varying its thickness at different points a gall can be so protected from saddle pressure that the horse, which would otherwise be non-effective, can be ridden with impunity. The numnah is valueless for this purpose. As regards the use of the blanket as a warm covering for the horse at night, it may be argued that the man will probably appropriate it for himself. He certainly may do so; but then the loss to the horse is a gain to the man, whereas the numnah is of very little use to either for this purpose.

Inspections of Backs and Saddles.

Frequent inspections of backs and saddles are necessary at all times, but especially are they of urgent importance on service. The horse's back is a highly sensitive structure, and oftentimes a very serious injury will arise from a very small cause. The hand should be passed carefully along the back of every horse daily, both in the direction of *and against the hair*, and any deviation from its natural condition should be at once noted and reported. These inspections should include all parts of the animal which come in contact with any portion of the saddlery or accoutrements. The smallest swelling, or accumulation of dried perspiration or scurf, may, if neglected, occasion a severe sore; and therefore the necessity for care and vigilance in making these inspections cannot be too strongly impressed upon all concerned in the welfare of our troop horses.

The above remarks will apply to the daily inspections and fitting of saddlery.

In conclusion, I am desirous of drawing attention to the advisability

of establishing a systematic and thoroughly practical course of training in the details of saddle-fitting for the prevention and relief of sore backs, throughout our mounted services.

Not only Officers, but every non-commissioned officer and man ought to know something about the structures upon which the saddle rests, the varieties of conformation, the causes which operate in the production of sore backs, and the expedients to adopt in order to prevent and relieve these injuries. How many men in a cavalry regiment know how a blanket should be folded to meet the various requirements of horses on active service? Very few, I fear; and yet this is a duty they may be called upon to perform at any time.

The subject of saddle-fitting has been exhaustively dealt with by General Sir F. FitzWygram in his pamphlet on "Saddling of Cavalry Horses," and also—from a veterinary point of view—by Professor Smith, of the Army Veterinary School, Aldershot, in a series of articles published in the "Quarterly Journal of Veterinary Science in India," 1883-84. The principles laid down are clear and sound, and as aids they are very valuable; but to be of real use they must be practically applied, and this can only be accomplished by a thorough course of training under competent instructors.

The CHAIRMAN: We all feel very much interested, and indebted to Inspecting Veterinary Surgeon Walters for the lecture he has given us. I shall subsequently ask you to give him a vote of thanks for his lecture, but before doing so it is customary to ask any Officer or visitor to offer any remarks upon the points which have been placed before us.

Lieut.-Colonel HUTTON: Mr. Walters has alluded to the saddle equipment on the dummy horse before us. I think, perhaps, a few remarks upon it, and also upon one or two of the most important points raised in the very valuable and interesting lecture which we have just heard, may be of use. The first point that I would touch upon in the course of Mr. Walters' remarks was with reference to picketing, and the difficulty experienced from galls of every kind. I would mention that the Italian Army have a system of picketing which, I believe, has been tried in India, but never on any adequate scale in this country, viz., picketing horses to an iron ring. Twenty horses are tied by their head ropes to a ring of 8" in diameter, and the horses are thus picketed in a circle. This is found to answer very well in the Italian Army, and it has, no doubt, the advantage of simplicity, and, further, all difficulty of having to carry picket lines, posts, or heel ropes, and pegs is obviated. With reference to the remarks that the lecturer has made about the value of a blanket under the saddle, in the course of a varied experience with troops mounted upon Cape horses, Cossack horses from the Don, Arabs, Syrian and Irish cobs, and English troopers, I have found that the chief difficulty lies in the fact that horses lose flesh on service very rapidly, as they are, for the most part, grass-fed when purchased, so that the saddle which fits the horse at the point of disembarkation or concentration does not fit it, perhaps, a week or fortnight afterwards. A blanket is absolutely invaluable in such cases, because it enables you to relieve the pressure from any given point on a horse's back. I think, however, that a blanket and numnah combined is a far preferable arrangement. There are great difficulties connected with folding the blanket correctly, and when a horse galls at any particular point, the blanket requires very careful folding to prevent a sore, and if men have to saddle up very early in the morning, before daylight, it is almost impossible to fold the blanket evenly and correctly. A numnah is, in that case, essential. With reference to the saddle equipment in use with our cavalry, it is, no doubt, satisfactory enough, but it has been made entirely for a large horse of 15.2 and upwards, and is not suitable for the class of horse

with which I have been thrown in contact—that is to say, a small horse—such, for example, as an Arab horse, or a Cape pony. Mr. Walters has pointed out in his lecture that our cavalry saddle is too long for the short-backed horse, as it is liable to cause both sores in the withers and also on the loins from the length of the pannels and bearing in front. In addition to this, the distribution of the weight is not, I venture to think, at all satisfactory for a small horse such as I have alluded to, measuring from 14 hands to 15 and 15.1. A great part of the weight is in front of the fore hand of the horse—the length of the saddle necessitates its being so. Again, the extra weight carried behind the saddle, the man's kit, is on the weakest part of the horse, viz., over the short ribs. These are the main defects that the equipment before you is intended to obviate. The weight which the horse has to carry should be in a line with and below the centre of gravity, and well clear of the short ribs, and in this manner the fore-hand is relieved of the great mass of dead weight which under the present system of cavalry equipment it now has to carry. The girth has always been a very great difficulty on service. The leather girth issued with our cavalry saddle is most difficult to keep serviceable. After the experience of several campaigns, I have always found that the leather gets so hard that it positively cuts the horse's hide almost, I may say, like a knife. It is impossible, as every man knows, in the field to get sufficient fat or dubbin to keep the girths soft, and the result is every sort of girth gall. Again, horses purchased at the point of disembarkation are, as I have said, for the most part grass-fed, and lose condition very quickly. It is impossible with the limited means at the disposal of a Commanding Officer in the field to shorten the girths sufficiently quickly to allow for the lessened condition of the horse. The result is the saddle oscillates, and you have sore backs. I advocate very strongly the adoption into the whole Service of a single girth similar to the one before you, which has been in use in America for the last fifteen years. This girth can be so tightened by means of the cingle straps and rings that it is impossible for the saddle to move—in fact, it can be tightened to such an extent that, were it desirable, you could almost cut the horse in two—the leverage of the double leather cingle strap is enormous. I hope that I may be pardoned if I allude to another difficulty that has always to be seriously encountered on a campaign when dealing with such small horses as I have described—and that is the weight of the present cavalry saddle and equipment. The saddle itself is an excellent one; the mounted troops with whom I have been associated have invariably used it; but it is very unnecessarily heavy for a small horse. The saddle equipment which I advocate, and which you see before you, is nothing more than the American Whitman saddle adapted to the seat that we term “a hunting seat,” though it has also many modifications peculiar to this particular equipment, more especially as regards the saddle-bags. This saddle and equipment is 17 lbs. lighter than the cavalry regulation saddle; and, in addition, the man's blanket is carried under his saddle instead of in the wagon with the baggage train. Saddle-bags have many advantages. I do not pretend to raise this point as regards the advantages of the use of saddle-bags by our cavalry, though saddle-bags are used by the American and Italian cavalry, because if the cavalry soldier has to ride in close and serried masses, saddle-bags must be more or less inconvenient; but it is with regard to their use by such troops as I have been associated with, and who ride 6 inches from knee to knee—generally more, never less. One great advantage of saddle-bags such as you see before you is that when horses begin to lose condition, or when horses are required to make forced marches, the whole of the saddle-bags can be detached, and thrown over led mules or horses. Again, the type of saddle-bags has been so arranged for this equipment that the weight is not back upon the loins and short ribs of the horse, which is the case usually with saddle-bags, and is especially the case with the saddle-bag in use by both the Italian and American cavalry; but in this case the weight is actually underneath the man, it is as nearly as possible under the centre of gravity of the horse, and rather in front of that point than behind it. It has been urged against such saddle-bags that the men will carry more than their own kits, &c. This was certainly found to be a difficulty by Col. Dartnell of the Natal Police, and so serious was it found by that Officer that, after a trial of four years, they had to be abandoned. Of course, the Natal policemen are not under the

same control that soldiers would be in this respect, so that difficulty does not apply to soldiers to the same extent. There is just one other advantage connected with saddle-bags which I would urge, which is that you put the whole of the great weight! our cavalry soldiers carry on the top of the horse, and if the man does not sit steady on his saddle, there must be more or less serious oscillation, and that means, as all old campaigners know, sore backs, especially if the girth is not very tight. I claim that these saddle-bags get over that difficulty to a very great extent, as I have shown.

Inspecting Veterinary Surgeon J. D. LAMBERT: I wish to make one remark as to the number of horses in the German Army in the last Franco-German War. On the 1st March, 1871, the Germans had 63,000 cavalry horses alone on French soil, and that was after they had had enormous losses. Then Mr. Walters has remarked on the excessive number of sore backs in Egypt. We all know that in a campaign there is a great deal in sore backs being reported. I have heard of a cavalry regiment making a long march from Hounslow to Edinburgh, and it was reported in some newspapers that it was done without a single sore back; we know that was quite impossible. This incident, however, occurred over twenty years ago. In taking statistics of sore backs, we must consider whether they have been reported, for very often they are not all reported. As to glanders, farcy, and mange in the army, when we were in Zululand with the 17th Lancers, I was Senior Veterinary Surgeon of the column that went to Ulundi; we had very little glanders, and none in the 17th Lancers. The reason was, so much care had been taken in the selection of the horses before we started from England. There certainly were some cases among the Colonial horses, but not nearly so many as you would have thought. In the 17th Lancers, with nearly five hundred horses, there was not a single case of mange during the colonial campaign. That shows conclusively, I think, that it is not, as people often suppose, generated spontaneously, but that it must be caught from another horse, because had it been capable of being generated *de novo* we must have had it in the 17th Lancers just as they had it in a few of the other corps. As to heel-ropes, I know they have been dispensed with very often. I have frequently seen a great many horses in the field. I take it that heel-ropes are very good things for English horses, because if they are at all in good condition they will kick at each other in the lines. As to using a blanket under the saddle, I had a great deal of experience of that in the 17th Lancers in the Zulu campaign. Our men generally saddled in the dark; it was the custom to "saddle up" about half an hour before dawn to be ready in the case of any attack; this was done every morning; our men had to fold their blankets in the dark. We paid a very great deal of attention to sore backs, and yet we never had a single sore back which we attributed to wrinkling of the blanket; therefore I am strongly for the blanket. In that campaign the extremes of heat and cold were tremendous. It was so cold at night that it froze the water in the little leather buckets we used, and so hot in the day that we could not go out in the sun without inconvenience. The blankets were put on the horses at night and so furnished a much needed warm covering. I was very pleased that Mr. Walters laid so much stress on the inspection of the horses' backs. That is the best way to keep sore backs away—a thorough daily inspection. My opinion is that the Officer of any troop of cavalry, or any unit of a corps, should every day carefully rub the hand along the horse's back, both with and against the hair, and any little roughness should be at once attended to. I think this should be done at least once a day; and if that is done carefully I believe that sore backs will be reduced to a minimum.

General Sir FREDERICK FITZWYGRAM: I made a few notes of what has fallen from the lecturer. He adverted to the advantage of a certain portion of the kit of cavalry being carried in light carts. The objection to that is that light carts

¹ The weight carried by the cavalry soldier, as per "Manual for Field Service," Cavalry, Appendix 4, issued with Army Orders, 1st November, 1888, is 127 lbs. 4½ oz., to which may be added 10½ stone for a light cavalry, and 12 stone for a heavy cavalry man, making together 19 stone 8 lbs. for hussars, and 21 stone 1 lb. for dragoons.

cannot keep up with the advance force of cavalry; they may when cavalry are marching in a large body, but for the ordinary duties of cavalry, when they are detached and have to go over country in which there are no roads at all, the system of light carts breaks down completely. The carts cannot keep up with the horses; and in making our arrangements it is necessary to provide for what may occur so that the kit may be available under all circumstances, which it would not be if it were carried on carts. Mr. Walters has stated with reference to the cartage of blankets that he has never seen the system of mats tried. Now, the only suggestion made in favour of mats was that where blankets and other articles of the same sort could not be obtained, it was very useful to teach the soldiers to plait straw, grass, and rushes, so as to make them *pro tem.* take the place of a substitute for the falling away of the horse. I have seen them tried, and they wear extremely well for a month or six weeks, and in probably much less time than it would be possible to get the material for re-stuffing the saddle. A suggestion is made about surcingle galls. The simplest way of curing a surcingle gall on service is to bend the numnah up double, so as to leave the space over the back open with only the one single thickness of numnah, and then the surcingle can be put right across without the least chance of doing any injury to the back. Colonel Hutton, I think it was, said the Italian system of picketing horses to an iron ring in the centre had not been tried in this country. It was tried at Aldershot some few years ago when I was there, to some considerable extent; but whatever the Italian horses may be—they may be a very stagnant breed, and this plan may answer with them, but our English horses invariably drag the ring away. Once or twice after leaving them for half a day horses fastened up in the South Cavalry *Mandé*-Ground would draw the ring down to the West Cavalry Barracks. Mr. Walters has adverted to some advantages, and some disadvantages, of blankets. I think the present small blanket which it has been decided to adopt answers all the advantages, and has none of the disadvantages of the blanket, and being small it can be enclosed, as it were, by small straps within the area of the saddle, and therefore there is no tendency to slip off. When I joined the Army, blankets were used in the light regiments, and there was a constant complaint of the blanket slipping over the horse's tail. Colonel Hutton also adverted to the great weight carried by cavalry. He stated it at 21½ stone; I think you will find the weight, under the present arrangement, at something under 17 stone.

Lieut.-Colonel HUTTON: 21 stone 9 lbs.

Sir FREDERICK FITZWYGRAM: I think you will find now that it is rather under 17 stone; and the weight of the infantry, taking the average of the men, I find to be very nearly the same as that of cavalry. I, of course, am aware that the Life Guards ride heavier. Then Colonel Hutton adverted to the advantage of a small saddle for a small horse. The real fact is that the size of the saddle depends upon the size of the man. If you have a man who is broad and stout you must give him a saddle which he can sit upon. The size of the saddle as regards the horse consists not in the length or shortness of the saddle, but in the narrowness of the saddle to fit upon the smaller frame of body; and I do not think that very much weight can really be saved if you keep men as heavy as we have them, whether mounted infantry or cavalry, by making the saddles much smaller than they are in the present day. There was a remark made as to some very forcible means of girthing up horses extremely tight. I cannot help thinking that that is extremely objectionable. It is objectionable as regards the horse, and it is a false principle to make a saddle fit by making a horse uncomfortable by girthing him up extremely tight. The question of sore backs will always be one of the care of horses. No saddle that you can make can possibly answer unless the Officers take the trouble to fit the saddle to the horse. There was a remark about the slipping forward of the saddles. I think that is in a great measure due, in most cases, to the side bars being too straight; because, if the side bars rest upon the hinder part of the horse, they miss him over the back and touch against the shoulder; the consequence is that horses get sores behind and sores in front. I think you will find that a prominent cause for sore backs. I am thoroughly convinced myself that the saddle that has been adopted in the cavalry is capable of being carried with fair care and fair knowledge on the part of the Officers without causing any

appreciable number of sore backs, however long or however severe the service may be.

Colonel GRAVES, 20th Hussars: The lecturer has taken up a very large series and a very large number of points, on which he has given us his opinion, and there have been a good many suggestions thrown out, and many valuable ones. I myself like the look of that girth as compared with the ordinary broad leather girth we have in our regiments now, which hardens, curls up, and, as has been already stated, positively cuts like a razor into the horse if not properly taken care of. With regard to sore heels, there is another very efficient cause of sore heels—which latterly, in our campaigns, we have had no experience of—*i.e.*, on the Continent we might perhaps have to work in very wet weather. Constantly standing up to the hocks, almost in mud, the heels being constantly wet, seldom dry, is productive, not only of sore heels, but, I believe, in large measure, under certain predisposing circumstances of a kind of farcy, too, in the long run. The drier we keep our horses' heels on service, when the weather is wet, of course, the freer we are from sore heels. A point that came under my own knowledge, when I was in Egypt, which is not touched upon by the lecturer, and which, perhaps, might be useful, just to put before the meeting, is this. When I was sent out to Handoub to command the mounted troops, I had two squadrons of the 5th Lancers, 225 horses; the 20th Hussars, 110 horses, and 89 mounted infantry horses there. Our work at Handoub, as compared with the work at Suakim, was, as it were, in rocky country, as compared with sand; all round Suakim being sandy plain, covered with mimosa bushes, with here and there a kor, at the bottom of which you find a certain amount of rubble or gravel, whereas close round Handoub it was very rocky, and the rock was granite. Well now, the point I should like to touch in connection with this, is the question of shoeing. We not only have a large number of casualties from sore backs, galls, and so on, but we have other casualties from improper shoeing. I will give you the figures of the casualties in one day during a reconnaissance, when I was ordered to go through certain passes in the mountains between Handoub and the south. The mounted infantry had 27 horses out and lost 17 shoes going through that one pass (many miles long, certainly). The 5th Lancers had 39 horses out and lost 27 shoes. We had 36 horses out and lost 6 shoes. I saw a number of mounted infantry horses positively bleeding from their feet. One horse had lost all four shoes. I think it is not only necessary for an Officer commanding troops in the field to run his hand down the horses' backs, but equally necessary for him to see that his horses are properly shod. Suppose we had to fight on bad ground, what use would a great number of these horses, which had lost their shoes, have been in an advance for any great distance at a gallop? Of course they would have left the best part of their feet on the ground, and our men would have been killed. I take it no point requires closer consideration and attention than the question of shoeing in the field. We have got a very useful system of cold shoeing now, and I have, in my own regiment, I think, some forty men who can shoe a horse on the cold system. I take it every Officer should have a fair knowledge of what the horse's foot is inside and out, and be able to instruct the men roughly as to the way of putting on shoes. There is one thing with reference to the shoes in the field which I think is deserving the special attention of our veterinary authorities, and that is the habit of our farriers of filing the tip of the nails, when it comes out of the hoof, after being put through the shoe, to a point, and then turning it down and making a very pretty little scintillating object on the wall of the horse's foot.

The CHAIRMAN: It appears that this subject is to form the basis of another lecture in a couple of weeks by the Principal Veterinary Surgeon. Knowing that, you may, perhaps, wish to reserve your remarks on shoeing until that occasion.

Colonel GRAVES: Very well. I may close that point by saying I am quite sure, from the remark that has been made by General Ravenhill, that you will have a very interesting lecture put before you, and useful instruction, by Dr. Fleming, when the times comes. There is another point that came up, which has not been touched upon by the lecturer, and which happened to us at Handoub. We had, besides the mounted troops under my own command, the Australian Artillery. They had a fine lot of men and a fine lot of horses, but, whilst there, there was very little for them to do, and their chief grievance was that they had no fighting. They

arrived there with their horses labouring under a very heavy, shaggy winter coat. Our normal temperature there was something about 118° up to 127° in the sun, and you can imagine what these horses suffered under, with their winter coats, whilst they were coming up the Red Sea. Apparently, through want of proper horse mastery, no attempt had been made to get these coats off. The result was, a number of these horses went down with sunstroke. In one day as many as twenty-one of them went down. What relief they obtained was through very excessive bleeding, so that the head was relieved, and the power of the heart reduced in the way of causing compression upon the brain, and then, when they pulled round a bit, this force was put under me for instruction in reconnaissance and outpost work; and the moment they got some work to do, and their skin began to work, and they got rid of their coats, they were entirely different horses. That is another matter in which, as the lecturer has put it, prevention is better than cure. They lost three or four horses from sunstroke before proper means were taken to get rid of it. As to sore backs, I think there is another point that ought to be borne in mind in this matter. It is not merely the question of the fitting of the saddle, or of the weight as deposited on the saddle, but in a great number of cases it is a question of proper horse mastery on the part of the men who have to direct the allotting of the work to be done. For a long time, at Suakim, the 5th Lancers, who, as the lecturer has stated, had sixty-eight sore backs in a month, were out from dawn to dusk; they saddled before dawn and came in after dusk: they had no rest. The work was not distributed properly, and the result was this terrible list of casualties from sore backs. The Commanding Officer came in from Handoub and complained several times that he could not carry on the work of his wing under those circumstances. Through the accident of rank he found himself junior to a young Officer of mounted infantry, a smart, keen Officer, but one who had not been a long time in the work, and had not been trained as mounted infantry are now being trained before they go to war—trained in peace instead of trained on the spot. This young Officer happened to be three or four months the senior to the senior Captain of the 5th Lancers, and he had the whole of his mounted infantry out, and the 5th Lancers at outpost and reconnaissance and convoy duty the whole day. It came to such a pass that a change was found necessary, and ultimately it fell to my lot to go out with my squadron and take over command of that body. When I got there I found that the convoy and outpost bodies, and reconnaissance bodies, were about double what was needed. I was able to leave half the whole available force in camp one day, and send them out the next. With the numbers at my disposal I was able to relieve each force that went out at dawn, at dinner-time, and so on. And what was the result? When Lord Wolseley came down to see us at the close of the campaign, he asked me how I accounted for sixty-eight or seventy sore backs in the 5th Lancers. I said it was a simple case of overwork—the horses never had any rest any more than the men. The men saddled up before dawn, and came in after dark. I told him, by altering the work and changing the whole system, the backs then sore were reduced to thirty-two—in three weeks; and in the majority of those thirty-two cases the horses suffering from sore backs could have been worked, had there been any pressing necessity for so doing. So on all round. The sore backs were reduced by allotting the work properly. It is, therefore, not simply a question of weight only, it is a question of how the horses are worked and when. I am glad to see this question of the blanket has been brought up again, but at the same time, I think, the system—if I may speak, subject to correction—that our War Office authorities go upon, in the matter of the appointment of Committees, is open to serious adverse criticism. I remember distinctly myself three Saddlery Committees; one Saddlery Committee suggests this or that, and makes its report for the confidential information of the Secretary of State for War; it is adopted, and the saddle introduced. About three years afterwards another Committee is appointed. They stultify the proceedings of the former Committee, so that the 1884 pattern saddle, with the high cantle, a very neat and useful saddle, if made properly, is put into the limbo of obsolescence, and we have another saddle introduced. It may be thought necessary, some time in the near future, to appoint another Committee, and the gentlemen acting upon the present Committee will be stultified by their successors. At any rate, speaking from one's own experience of cavalry

saddlery, I do think the weights are much too high off the horse's back. As has been suggested, the centre of gravity of the total mass ought to be below the centre of the mass itself. It is not so with our cavalry horse; and if a certain regiment of our Service had to swim a river at this moment, I believe nine out of ten men would simply turn turtle. That requires very serious consideration. I do not see how those saddle-bags can be adopted for cavalry; they are too wide. We do not ride touching knee to knee. We are supposed to ride a yard in lateral width. I think that saddle would be much more like 4 feet or 4 feet 6 inches wide at the outside of the bag. Then the question of feeding comes in, regular feeding, constant feeding, regular watering, and constant watering, where it can be got. These are all things needed for carrying on protracted marches and working in the presence of the enemy in tropical climates. It is not giving a certain number of buckets at certain hours of the day, but when a man on service is dismounted, either with the support or reserve of the outpost screen, he has opportunities of hand-feeding the horse: that might very easily be done, and is a better system of feeding, carried out, than at present exists. I think the whole meeting will be quite in agreement with the view that we are much indebted to the lecturer for the very able way in which he has dealt with the subject. There are many things in the lecture which will make it a very valuable addition to the Journal of the Institution.

Dr. GEORGE FLEMING, C.B. (Principal Veterinary Surgeon): I should like to avail myself of the presence of Sir Beauchamp Walker to inquire if he can inform us as to the percentage or the number, or give us some idea as to the sore backs in the German Army during the campaign of 1870-71. If you remember, Sir, there were reports in the papers as to the great success of the German cavalry in protecting sore backs. I think the "Times" reporter said that after the campaign the number of sore backs was almost *nil*. It has always appeared to me to be a most incredible thing, because the work done by the German cavalry was excessively heavy, performed in all kinds of weather, and the weights carried by the horses were not much less than those carried by our own horses. The matter of sore backs is a most important one for cavalry; in fact, we look upon the presence of sore backs in a cavalry force as a very serious thing indeed. Any means of preventing them must be hailed with great satisfaction by our mounted forces, and especially by cavalry. I think myself that the top hamper upon the saddle is one serious cause of sore backs; the weight, if possible, should be brought down at least to the level with the arches of the horse's ribs. The valise and top gear put upon the saddle causes oscillation, which undoubtedly produces injury. The great object, in addition to having the saddle well fitted, is to diffuse the weight over the back as much as possible. I remember in North China the Tartar cavalry, mounted on small ponies, were remarkably free from sore backs. We captured a number of ponies from time to time, and it was rare indeed to find one with a sore back. The saddles were of the simplest description, a little wooden frame with the side bars very short—no panels—placed upon a great thick mass of felt. It is astonishing the long distance the Tartars will travel on these ponies without sore backs. The great object, of course, is to diminish the weight on the cavalry horse's back, and get it, if possible, from the top of the saddle. Sore backs owe their production to a number of causes, but the chief is the top hamper, producing oscillation. Get the weight as low as possible, teach the men to ride properly and saddle properly, and I think there is a chance of sore backs being dispensed with. With regard to contagious maladies among Army horses, our Army now could take the field perfectly free from the most serious of these. We have not had a single case of glanders in the British Army during the last year; therefore our horses taking the field should be free from this scourge. The great danger is in remounting the troops in the field. Glanders prevails in several countries to a large extent, in fact in almost every country from which we should have to draw a supply of horses, and therefore the greatest care will have to be exercised in obtaining remounts free from infection. If we can keep our horses free from contact with diseased horses, we shall have no contagious diseases. These maladies are solely due to contagion. I should like to ask Sir Beauchamp Walker with regard to the German cavalry horses. I am certain our British cavalry men are as good soldiers as the

Germans and as careful about the horses. If the German cavalry force could act in the field for such a long time without sore backs, we should like to know how it was managed.

General Sir BEAUCHAMP WALKER: I am afraid I can give our good friend, who I hope is going to favour us with a lecture on shoeing within a very short period, very little information. I have no veterinary Returns of the campaign of 1870 and 1871, but certainly, looking at the matter as an impartial observer, the number of horses unfit for service in the cavalry which I came in contact with was very small; but as to saying that there were no sore backs, it is simply nonsense; sore backs will always occur. The German saddle at that time—it is twenty years back—was a wooden saddle without panels, placed on a blanket, and a great part of the men's kit was, as well as I remember, also under their bottoms over the saddle. They had much larger wallets than this, and they carried very much less kit. One very fine remedy for the prevention of sore backs, which I practised when I was commanding a troop of cavalry on a good many longish marches, was that when a soldier sore-backed his horse, I made him always walk till it was quite well. I did that the first march we had with two men, and I do not think I ever had another sore back on the march the whole time. I am quite in agreement with all that has been said about the great necessity for extreme care on the part of troop Officers in looking after their horses, and I certainly feel justified in speaking to the extraordinarily careful manner in which the German Officers do their duty, and to that I think may be attributed a great immunity from sore backs in the German cavalry. I do not at all imply that our Officers do not do their duty, and do it thoroughly, but certainly the way in which the German Officers do all their duty is an example to any and every army in the world.

The CHAIRMAN: Gentlemen, I think the remarks we have heard, consequent on the lecture, have been such that we may all gain great information from them. I agree with what General FitzWygram said about the responsibility of Officers. The results really depend upon the care which individual Officers and Commanding Officers take in looking after their horses. I think the whole thing centres on that. The man who studies the animal and its condition is the Officer who will bring his horse to the front in the best possible form in the hour of need. Easing the horse whenever he can, whether it be done by constantly taking care to dismount the men at odd moments, and never to give unnecessary work to be performed; then he should water and feed his horses where an opportunity offers. I think great stress should be laid on the subject of water; all horses, especially troop horses, suffer greatly from want of water. We cannot be too careful in attending to that and also to the nature of the water supply. I am not quite sure whether Mr. Walters laid sufficient stress on this last point. I believe a very great deal of this sickness both in Egypt and at the Cape, and I know in India it is the case, and that a very great deal of that Loodiana disease we come across out there, is due to the impurity of the water which the horses have to drink. The horses of the Horse Artillery and of the 7th Dragoon Guards at Cairo suffered very much. I think I am right in saying, with regard to the 7th Dragoon Guards, but I know it was so with the R. H. A. horses; I traced it back at the time to their being billeted in an old barrack stable or courtyard in Cairo, where the water supply was very impure. It becomes a question also whether that was not the principal cause of all the frightful low fever that those horses suffered from. In a battery of Horse Artillery which came home from Egypt and which went to Coventry, I saw it a week after it arrived and more than half the horses were in the most deplorable state. About forty-seven died in that one battery. Conceive such a loss! It may thus be gathered from what Mr. Walters and others have said, how important it is for Officers to think of what they are doing in the shape of watering and feeding and looking after their horses. I am sure Officers intend to do their best, and if it is not done it is not from want of intention, it is the want sometimes of proper knowledge. It would be interesting at some future day if we could be told how far those diseases that are so prevalent in South Africa, "the horse-sickness," and this fever that appeared in Cairo are in any way of the same nature as that Loodiana disease which occasionally breaks out in epidemic form in India. I have never heard this subject discussed, and think it would be a very valuable thing to have

brought forward some day. A very great deal of the sickness and disease that horses are subject to on a campaign is no doubt due to the horse's debility, and there, again, the question of feeding and watering becomes prominent. A horse, when he once becomes weakened, gets in such a condition that he is subject to take glanders or, indeed, a thing like ringworm will affect a weak horse in such a way as to make him unserviceable. If a horse has ringworm on his back on the saddle place you cannot saddle him. Mange, I notice, is said not to have been very prevalent or not found in Egypt, but all those diseases in which there are parasites are greatly aggravated from the horse being in a weak condition. With regard to one or two remarks that have come from Colonel Hutton and from other gentlemen with regard to the hardening and curling of the girths, which, of course, would gall a horse, I consider a girth gets into this condition from want of care. I have tried web, hair, also leather girths; I have tried the split and plaited girths; they all require care. The leather ones must be kept supple with soft soap or grease or oil, or a very good substitute for that is ordinary "elbow grease," which you cannot always get applied; but in the absence of other lubricants it does a great deal of good. Another great cause of sore backs is the removal of the saddlery or numnah too soon when the horse's back is still hot and wet. I think great stress should be laid on this. Another point is that Officers should make every endeavour to get their saddlery and the panels of their saddles dried or aired as much as possible. I know perfectly well on a campaign it is very difficult, almost impossible, to do this, but every opportunity should be taken when the sun is out to turn the panels of the saddles round to the sun and get them dry, or in any other way within our power. Stress has been laid by the lecturer and also by Colonel Hutton with regard to the form of the mounted infantry saddle and to the saddle bags generally; the whole of this question is very debatable. A steeplechase rider or a man in the hunting field takes all the weight he possibly can off the back of his horse and off the back of the saddle. I like seeing the weight as much as I can within reason towards the forehead of a horse. If you hamper up a horse's hind-quarters with weight and he gets into difficulty he cannot get out of it. I am a heavyish man, and I always like to get my weight as much forward as I possibly can; one stands up in one's stirrups and gets the weight over the horse's forehead if possible. Therefore, although I must admit what Dr. Fleming said as to the weight of the valise and the weight above the saddle affording a tendency for the saddle to roll on a horse's back, still there is a very great objection to getting the weight too low. I should not like any such an arrangement with a horse of mine that I wanted to gallop with my weight for any very great distance. There is one thing with regard to the folding of the blanket under the Regulation saddle. Every one knows, and I remember perfectly well, in the Crimea we used to have great objections raised to the blankets from the creased folds; for all that we stuck to them, although we had numnahs sent out at the end of the time, which we put under the blankets. The numnahs certainly saved the horse's backs from the unevenness of the blankets, but then there was the extra weight. To obviate all this the Germans are very particular about the folding of their blanket. Stress was laid upon that point by Mr. Lambert, and there is no doubt that if you have the luck to be possessed of blankets stick to them, do not give them up, but get the men to clean, shake, and fold them properly. The Germans have a system of folding their blankets in three; they always employ two men to do it; they fold the blanket longitudinally in three and then again in three; and they have a very natty dodge which obviates the possibility of the blanket slipping from under the saddle. They turn up two corners in front of the top fold of the blanket, drawing them up under the man's wallet, fixing them with the wallet straps, and so prevent the blanket from slipping back; it cannot move. If something of the sort were introduced in England it might be a good thing. There is no doubt that the blanket is a very serviceable article, and I agree with what the lecturer said, that it is as good as a feed of corn in twenty-four hours to keep a horse warm. There is one other point touched on, and as I was one of those who first introduced the subject in this Institution some years ago I should like to touch on it. Mr. Walters, in referring to "the horse supply" and "the reserve of horses," says: "I believe I am correct in stating that, for the first time on record, arrangements have been made to establish—upon a complete and satisfactory basis—a

reserve of seasoned horses." I am thankful to say that is completed. We have now on a register a reserve of horses for cavalry or draught purposes which we can put our hands on within forty-eight hours in case of an emergency. Thanks for this are due to the owners of large numbers of horses, including masters of hounds all over the Kingdom, who have voluntarily placed their horses at the disposal of the country. There has been a certain amount of opposition connected with this registration on the part of some of the large companies in London, but we only want 14,000 at present to complete our requirements, and we have had far in excess of that number offered. The way in which the masters of hounds and other owners have come forward to offer hunters and horses to the Government is really beyond all belief. It is, of course, done entirely in a patriotic way, and the Government have already accorded their gratitude to all for the same. It is not, therefore, for me to dwell on that subject, and I should not have alluded to it if it had not been touched upon in the lecture. I am sure you will allow me to convey your thanks to the lecturer for the very able and interesting way in which he has brought this subject before us.

Mr. WALTERS: Lieutenant-Colonel Hutton advocates the use of a blanket in addition to the numnah under the saddle. The objections to this system are that the blanket would be too light and small to be of much benefit as a warm covering for the horse, or for the purpose of folding, either to protect a gall or to remedy the misfits of a saddle. With a good stout blanket no numnah is required, and if *properly* folded it cannot slip from under the saddle. The German system of folding is an excellent one. Lieutenant-General Sir F. FitzWygram considers a small blanket, if used with the numnah, possesses many advantages, and none of the disadvantages, of a larger one. I can only repeat what I have already stated in reply to Lieutenant-Colonel Hutton's remarks on this point. As regards the objection to the heavier portions of the man's kit being carried on wheels, I would submit that small bodies of cavalry, temporarily detached from the main force for any special purpose, would, in all probability, go as light as possible, and consequently a troop wagon or cart would be an unnecessary accompaniment, but I venture to think that properly constructed vehicles of this description would have no difficulty in keeping up with cavalry under any ordinary circumstances. I quite agree with the remark that the present saddle can be used without producing sore backs, if the necessary precautions are taken. It is the neglect of these precautions that does all the mischief; hence the stress laid upon the necessity for the exercise of care and vigilance, and the advisability of establishing a systematic course of practical instruction in saddle-fitting. Colonel Graves has remarked upon the necessity of good horse-shoeing in the field. This subject does not form a part of my paper, but I may say that it is one to which every attention is given on home, foreign, or active service. I have a distinct recollection of the casualties referred to during the expedition from Handoub. No ordinary system of shoeing, however good, could withstand the wrenching effects of the sharp jagged rocks amongst which the horse's feet were frequently wedged. I do not, however, remember hearing of any lost shoes amongst those native horses which were shod with Turkish plates. With reference to farcy being caused by wet and dirt, I need only remark that this being a specific disease, it can only be communicated by the invasion of a special virus, and cannot be produced by any external irritants. Colonel Graves remarked upon the evils of rasping the clenches of the nails in shoeing. This practice is strictly prohibited in the Army.

Friday, March 7, 1890.

GENERAL SIR DONALD M. STEWART, Bart., G.C.B., G.C.S.I.,
C.I.E. (Bengal Staff Corps), in the Chair.

MEDICAL SERVICE IN MODERN WAR.

By Surgeon-General J. A. MARSTON, M.D., C.B., M.R.C.P.

When the Council of this Institution did me the honour to ask me to give a lecture, the subject of "medical service in modern war" seemed a very good one; but the more I thought of it the bigger it loomed, and at last I came to the conclusion that the best thing would be for me simply to sit down and write, as children say, out of my own head the thoughts that came into it. A medical service is regarded somewhat differently, according to the stand-point from which it is viewed: there is the military stand-point, there is that of the public, and there is the stand-point from which the medical Officer himself regards it. The military stand-point—that from which Sir Donald Stewart would regard it, I suppose—would be that he should have as many healthy men as he could, and be relieved of the responsibility of the sick and wounded: that these latter should be properly housed and cared for; that the hospital should be clean and orderly; that there should be no complaints; and that the medical service should be a help and not a hindrance. I think that that is a perfectly common-sense, just, and right view to take. As to the public, although they may be misled for a while and in doubt, or unduly elated or depressed, still they are reasonable and just, and soon adjust the ballast of their judgment in such a way as to arrive in the end at a sound conclusion. With regard to war correspondents, they desire, I have no doubt, to do that which is right, but of course their reports are necessarily hurried, and their view is somewhat perfunctory. A certain number of them, I suppose, have a sportsman-like spirit: they go out to see what they can shoot, and the medical Officer who comes across such an one has probably rather a bad time of it: he gets some peppering from the Press: if he comes out of it all right, well and good. Then there are the patentees, who manage to have a good deal to do with the medical service in modern wars. When you are very busy, perhaps, making arrangements, they come with various suggestions and articles, good, bad, and indifferent. They have clothing, equipment, and all sorts and varieties of portable foods, and almost always new portable filters, and various other things too numerous to mention. Some of them are very good probably, but here is the difficulty: if you were to start a soldier off on the march with his kit and ammunition, and all these safeguards to health in addition, he would probably lose through his skin, in perspiration, a larger quantity of water in an hour than he would filter through his water-bottle in five. Then there is the way in which the medical Officer regards it. I take it he should say—What is the number of men and amount of material I have had, and what use have I made of them? A tree is known by its fruits. What have been my fruits in this campaign? What have been the results in the cases of disease and wounds treated in these hospitals as compared with previous wars? What has been the opinion of the non-com-

missioned officers and men who have passed through the hospitals; and has my service been so conducted as to have been a help or not to the General Officer in command? If he can give a satisfactory answer to all this he is very well pleased. With regard to the subjects of which I am about to speak, some of them you may say are laid down in the Regulations and ought to be very plain. I dare say they are, and no doubt they are very plain, but a thing may be laid down very lucidly in Regulations and yet it does not work in the field. It may be as plain as, for instance, the figures on a clock, but then there is this difference between the clock and a Regulation:—the clock strikes, but the salient points of the Regulations do not always strike the reader. And it often happens in war that Regulations, however plain, cannot be appealed to, or practically applied. Of course soldiers exist for the purpose of fighting, and they fight to win; consequently everything must in war be subordinated to military success; but to carry this out the head of the medical service in the field must be acquainted with the object the General has in view, and must be in his confidence. I have thought it better to make these few prefatory remarks rather than put them down in writing.

It has often been said that the English are not a military people, but that they are a warlike people. Be this as it may, we are always engaged in some small war or other. Since the date of the Crimean War there have been some twenty campaigns of sorts in which some portion of the British Army has been engaged. As a distinguished German Officer one day remarked to me, "You British are always making all sorts of experiments for the information and benefit of other nations." Of course he did not mean that we ever undertook any expedition in the interest of other people, for he probably shared the common belief that we are a selfish as well as an insular Power. We do not fight for an idea, like the French; we have no exposed frontier conterminous with some neighbouring Power desirous of overreaching his neighbour's landmark, appealing to our fears and patriotism on the one hand, or our aggressive instincts on the other, like Germany and France; nor are we the inheritors of a destiny, as it were, in which our racial instincts, aspirations, or hatred, propel us in dangerous directions of an inevitable collision with other races and nationalities, like Russia, Turkey, and Austria-Hungary. Still, we have possessions and interests everywhere: and as the strength of a chain is just that of its weakest link, so are we vulnerable in our outlying extremities in all directions, and as a consequence we are always having some small fight or other on hand; and the curious part of the thing is that—strange as it may appear to the British public, to whom all wars are alike, and whose knowledge of modern military history is drawn from the pictorial effect of the rainbow row of orders and ribbons they see on the undress uniform of some General at a review—the curious part of the thing is that we have had no recent experience of war with an European Power, and, what is more, no two wars or expeditions in which we have been engaged have resembled one another, and scarcely one of them resembles the wars of other European nations.

We exhibit, too, a curious combination of opposite qualities. We complacently pride ourselves that we are not as other people are, as regards our motives in undertaking war, although we know that we only go to war where and when we conceive our interests demand it. Our public journals decry one statesman who speaks the bald truth in

such matters, and extol another who makes some sentiment do duty for reason; and yet it is indubitably true that, as a nation, we sincerely desire peace, and that every Government and political party is bent on preserving it, and "funks" war, if for no other reason than that it is jeopardizing its own stability and safety. We pride ourselves, however insular each individual Briton may be, on being an eminently practical people, and yet we slavishly follow hastily in the footsteps of any and every Power that may happen at the time to have been successful in the field, perfectly regardless of whether their systems and methods are at all applicable to our own institutions or wars; and we are perpetually decrying ourselves and our methods, whilst those who are most actively engaged in doing so are probably themselves creating obstacles to our securing that efficiency and economy at which they pretend to aim.

I think it is Carlyle who says that it is well occasionally to sit still and label your thoughts. Allied to this process of mental stock-taking, there is another and more practical procedure, that of gauging the tendency of certain movements going on around us.

War is admittedly horrible: it is an epidemic of wounds and injuries: and the responsibility of those entering upon it is universally recognized. But if the populations of neutral Powers step in with international systems of relief and organized ambulances the effect will be, in some measure at any rate, to relieve the belligerents of the cost and responsibility of war by relieving them of their sick and wounded, and so enabling a War Minister or General to prosecute a campaign with greater energy, celerity, and vigour, and to throw into the purchase of war-material the sums saved in not having to provide for those sick and wounded; to say nothing of the risk of an International Aid Society being unable to balance their services equally and fairly between the two belligerent forces.

The object and intention of a National Aid Society is a different and more logical one. On a large scale—in a big European war—no Government could probably cope adequately with the requirements by the official methods and means at its command, and the national sentiment, which could not but be aroused, might be utilized with good effect, if the efforts be systematized and regulated, instead of being frittered away in misdirected attempts at miscellaneous aid. In connection with these national movements there has grown up a system of aid to sick and wounded. Ambulance associations, bearer drill, and other organizations, have sprung up everywhere; and in process of time, if the popular movement continues to develop itself, the United Kingdom, or, for that matter, Europe itself, will be covered with a network of organizations of this sort.

The movement deserves support and encouragement, for it is likely to be practically useful in various ways. Obviously this diffusion of information as to practical and simple methods of procedure in cases of accidents, if it were even restricted to telling people what not to do, would be useful. But all movements based on popular feeling are apt to assume exaggerated proportions, and exalted ideas are entertained rather than practical and sober ones. The once hard-

headed and practical British nation seemingly, now-a-days, must have an object of hero worship: something on which it can "gush" superfluously: to-day it is some statesman: to-morrow it may be Jumbo; or it takes up some idea with a practical and useful, but limited, side to it, and straightway exalts it into "a fad."

It has almost come to be an article of popular faith, if not of popular conviction, that you can, by a very limited training, convert any intelligent but uneducated individual into an expert and skilful dresser of wounds, through the instrumentality of a process indissolubly connected with surgical aid to the wounded, viz., antiseptic methods of dressing, in reality, a far more refined and difficult method of procedure than is commonly imagined; and that you can teach any number of men at once, as a drill, what must virtually be acquired as the result of personal observation and experience based upon an intelligent and lively appreciation of the principles of the method.

The fact is that in a big war, after a really big battle, by no reasonable provision beforehand could the adequate amount of aid to the wounded be supplied promptly and at once, although the modern methods of field medical organization are probably the best that could be devised for stripping the battle-field of its wounded. And in many of our small wars with semi-civilized peoples, unprovided with arms of precision and all the modern warlike inventions, the aim should rather be to bring the hospital to the wounded than the wounded to the hospital; and for this purpose the lighter and more movable the hospital equipment the better. But war is war: and in order to accomplish this it is ridiculous to suppose that you can provide luxuries in order to keep pace with a luxurious age, or have a section of Savory and Moore's shop, with its refined method of multiplied medicaments, in the rear of your lightly equipped field hospital: nor is it at all necessary, if the well-being of the sick and wounded is to be the real and only consideration—the greatest good of the greatest number—and the public are not aimlessly demanding "the mint, cumin, and anise, while neglecting the weightier things of the law," and Medical Officers are content to restrict themselves to what is essential to the care and comfort of those for whom they are responsible.

Under the circumstances of war everything depends upon a clear appreciation of the medical requirements and a right method of fulfilling them; in other words, upon a simple and effective administration, that is, a due provision and proper distribution of men, material, and transport.

The *desiderata* of a medical and hospital service accompanying a force on active service are manifestly that it shall be efficient, that it shall dispense with any needless reduplication of stores and appliances, and that its transport shall be reduced to the lowest mark consistent with efficiency. Let me here illustrate this. When an army corps from India for Herat was talked of in 1885, it was found that the 30,000 soldiers composing it would require, on an Indian scale, 30,000 defenceless followers and 30,000 animals; in all 90,000

eating units; and, what with sick, duties, and the defence of followers and animals, the 30,000 would practically give only about 20,000 soldiers to fight with. How did Alexander the Great do, when he penetrated into India through Afghanistan?

The fact is, that a medical head requires to be a man of courage and character in these days, to be practical—do his level best and take the consequences. He can then, in any case, count upon the approval of his conscience if he can count upon nothing else.

The present hospital system is a consolidated one, and its leading advantages mainly consist in its defined purpose and method in the arrangement of details. Its objects are to equip corps and hospitals actually in the field with a limited but adequate supply of selected materials duly arranged; to appropriate Medical Officers and establishments to positions where they will be most needed in actual warfare, viz., to sick, medical duties and hospitals, instead of to healthy men of regiments and batteries, and not to waste skilled medical labour, or encumber a moving column with any unnecessary impedimenta, whether these consist of stores or sick; and the pivot of the whole system is to free the fighting force in front as much as possible by relegating the sick and wounded in the direction which they must eventually take, if they prove inefficient, namely, to the rear.

The expedition into Afghanistan in 1878 was the first occasion on which the general or consolidated hospital system was adopted and followed in India; and the organization and arrangements that have since been introduced in that country have been mainly based upon the experience then obtained.

The evils of a defective hospital system cannot be confined within the limits of that branch of the service only, but are reflected on the army system as a whole; for the freedom of movement of an army will manifestly be in direct proportion to the degree to which it is freed from stores, transport, sick and wounded, and the power of those in command will be increased in proportion to their being free to act untrammelled by any other than strategical considerations; and, as regards the sick and wounded, the evils are augmented and may even be disastrous. The individual efforts of the ablest surgeons in a big war count for very little in comparison with the good which can be effected by a simple and effective medical administration. The skill of the best surgeon or physician will be of very little avail unless his patients are brought to him in a condition to profit by that skill, and are lodged, fed, and transported from him in such a way that those evils and complications—which are not very remote consequences of the constitutional infection from wounds and operations—have not been engendered; or, at any rate, that the good which has been done is not undone or counteracted. The better the doctor the more imperative it becomes to him to be well assured that the system which deals with and provides for the safety of the sick and wounded in the aggregate is based upon sound and practical principles.

Our arrangements and preparations for war are not, as a rule,

undertaken and prosecuted in a sufficiently business-like manner, and there are various reasons why this is so. There are, first of all, the political reasons; the Government does not make up its mind until the last moment, or, having made it up, keeps the fact religiously to itself, or even allows it to be understood or promulgated that nothing is further from its intention than war. Then, their determination being known, everything is at last carried out in a tremendous hurry, and everybody concerned is overwhelmed with work. The Government executive machine, consisting as it does of many departments and branches of the Service, is, under the best of circumstances, a difficult machinery to adjust in harmonious action—all its interdependent parts in unified simultaneous work. The responsibility and power of independent sections require to be exact, defined, and commensurate with the work in hand in order to avoid indirectness of aim and loss of power. No doubt, of late years much has been effected in the way of a more simple and effective method of procedure by the constitution of a War Committee, composed of the different heads meeting together, each prepared with a *précis* of its own requirements and suggestions for consideration and decision. In times of peace an immense fabric of orders and regulations is, for ever-varying financial and administrative considerations, built up, and it takes time to break through the habits in which all have been trained under a system of over-regulation. The first and most natural thing is for an official or a soldier to have recourse to regulations, army orders, and War Office circulars, rather than to recommend a course of procedure "out of his own head" in accordance with the dictates of his own judgment and common sense. It is a time when you emphatically need men to push measures that are direct and to the point, to have opinions and the courage of them, and to be capable of putting all they have to say on a sheet of note-paper, the details necessary to fulfil their requirements being left, as a matter of course, to be carried out by the responsible executive.

The first and most obvious thing in war is preparedness. It goes without saying that, other things being equal, the longer the notice the better the arrangements for any given expedition. It appears as if it were a matter of common credence, that it is just as easy to open out a system of field hospitals as it is to open an umbrella, and this idea prevailed apparently in India at a time when there was no such field hospital system in existence as there is at present. In the Afghan War the troops took the field on the 21st November, 1878, for the attack on Ali Musjid. One Division had actually taken the field before Government sanction had been officially given to the system of field medical organization and administration that was to be adopted; and the date at which the campaign was expected to open was only intimated to the Surgeon-General at Simla, the responsible medical head, in a non-official communication dated the 13th November. Throughout the earlier part of the operations there was the same tardiness in assenting to the most essential details. Happily this state of things no longer exists, for the Indian Government has since authoritatively laid down the system to be followed, and has

now all its equipment packed ready and at once available for a certain number of army corps.

I do not think that people have any idea of the amount of useful practical information and of fruitful suggestion that a medical bureau could oftentimes afford, or of what aid even one well-trained and experienced Medical Officer of sound judgment can occasionally furnish. It has always seemed to me that the physiological and medical knowledge of the medical service is not utilized to the extent it might be with advantage to the State. Of course I am quite aware that it would be ridiculous to attempt to regulate an army or arrange an expedition on *doctrinaire* principles, and in accordance possibly with some medical or physiological fads.

But let us suppose—and the supposition is in accordance with facts, for the greater number of our wars are small ones in tropical or semi-tropical climates—that a small expedition is about to take place in a hot, malarious country where there is a liability to fevers of all sorts, and that the campaign is expected to be a short one.

The first and most important thing to be done is the selection of the proper season; the next of the proper and best class of men, as regards age and previous service, for such an expedition; and, lastly, that of making the essential and common-sense arrangements required for them when they shall have arrived and disembarked.

I want to bring this out in the course of the following remarks about the preparations for war; and I do not think it can be better illustrated than in the contrast between the results of the Ashanti Expedition of 1873-74 and previous expeditions in that country, or with those of our first occupation of Cyprus. In my experience there has been only one occasion in which the Medical Service, from the initial stage to the final close of the campaign, has taken a leading, prominent, and directing part—the Ashanti Campaign; and, considering the difficulties and uncertainties of it, and the medical records of previous expeditions, it was a most successful expedition; its success being largely attributed to the knowledge and influence of the Medical Service, as represented by the late Sir William Muir. It was called “a doctors’ and engineers’ war.”

The choice of the best season for an expedition may be of enormous importance; in fact, it may make all the difference between signal success and disastrous failure.

It is not a question of exposure to heat or cold; for troops can, if properly equipped and selected, withstand almost extremes of temperature in emergencies and under the excitement of war. Take the Indian Mutiny and the various Egyptian and Nile Expeditions, for example, on the one hand; and the armies composing the Khyber Pass, Kurram, and Candahar columns, and the troops on the heights of Gundamak, and in and around Cabul during the winter and summer seasons of the last Afghan Campaigns, on the other.

If you march troops to Peshawar, between September and December, you may expect to encounter a large amount of inefficiency from malarial disease at that season. If you have to send troops through the Terai at certain seasons the same thing will occur; and

the loss of life, if it be a year of epidemic cholera in the north-west of Bengal and the Punjab within monsoon limits, by their movement through those districts during or immediately after the monsoon, may be enormous.

As regards the selection of troops, the contrast between European and Native regiments for an Indian campaign is noteworthy. The former die of the heat in the hot season in the plains of India; the latter (the natives) perish of cold in winter, especially in the higher latitudes. The knowledge of this fact may alone form an excellent guide for furnishing recommendations as to the best composition of a force. Then again, the important influence of the *previous* medical history on what is to become the *subsequent* medical history of a corps has long been well known, and is very significant. Regiments that possess a malarious medical history, whether European or Native, will be almost sure to have recurrences of malarious disease at certain seasons, or to suffer unduly from pneumonia and pulmonary disease in winter. Other things being equal, corps affected with malaria exhibit pretty constant and consistent statistics, viz., high rates of sickness and mortality following exposure. Moreover, the younger in point of age, and less acclimatized in point of service, your European troops, the greater will be the sickness and inefficiency from fevers, and notably from enteric, or typhoid fever, during a summer or autumn campaign in a hot climate. The disease of which young and unacclimatized soldiers die in India and hot countries is typhoid fever. The liability in the case of a soldier of over seven years' service in India, for example, to die of this fever is only 3·87, as contrasted with 82·44 in the young and recently arrived, and 13·69 in the class resident from five to seven years, reckoning the liability at 100. The importance of these considerations in determining the selection and composition of a military force for any projected expedition is obvious; and there are other considerations, too, of a physiological character regarding the relative liability to certain diseases of different races and of different temperaments of the same race, which deserve more attention than they receive at present, where the composition of a force for any particular expedition has to be determined. On these there is no need to dwell at the present time: but, *en passant*, I may remark that they did not escape the penetrating sagacity of Darwin to inquire about, a quarter of a century and more ago.

Dr. Johnson probably hit the mark in his impromptu lines to Mrs. Thrale, when he said that "life declines from thirty-five." A soldier from twenty-five to thirty-five years of age, with some two years of previous foreign service, is about at his best for a campaign, or for service in any climate. He has the maturity of early manhood while still retaining much of the prodigality of life and resiliency characteristic of younger men.

But to return to the subject of the Ashanti Campaign, in connection with the importance of selecting the right season for an expedition.

At the Gold Coast the wet are the unhealthy seasons. They are

two, March to May, and August to October. The healthy (dry) season is from December to March.

It was emphatically pointed out to the then Minister for War that there was a limited season of comparative healthiness, corresponding to the driest part of the year, and that during this, with proper precautions, Europeans might undertake field service in the country without any great risk to health. Except in the special limitations as to time of landing and length of stay in that country, the conditions laid down simply comprised points of routine sanitary precautions, together with such special arrangements as appeared advisable under the circumstances.

The proposed expedition to Ashanti was at the time almost universally condemned by the organs of public opinion, which were filled with predictions of the probable disaster that would ensue; and these gloomy prognostications were backed up by an appeal to our past experience, and to the facts connected with the past history of that country. Life assurance companies would not accept the risk of assuring the lives of individuals going there (if previously unassured). A detachment of a corps of white soldiers—the Royal African Regiment—serving at Cape Coast in 1824, lost by death from disease 98 per cent. of their strength in that year, and 54 per cent. of the detachment, recruited by a fresh draft, died the following year.

The abortive expedition in 1864, designed to undertake the very same operations contemplated under Sir Garnet Wolseley, returned unharmed by the enemy, but suffered an appalling loss from sickness. And almost up to the time the expedition was undertaken there had been a similar experience with the body of Royal Marines at the Gold Coast (18 deaths amongst 104 men), with shattered health of the survivors.

These results can now be contrasted with those ensuing, when it is possible to select the proper season for operating in an unhealthy country, and suitable measures are taken beforehand to obviate sickness. The mortality of the force which, under Sir Garnet Wolseley, marched to Coomassie, was at the date of four months after the country had been left, only 3.14 per cent. of the strength disembarked—81 deaths from disease and loss in action, in 2,587 European Officers and men.

Sir Anthony Home, the Principal Medical Officer of the expedition, in his official report, says: "Every point connected with the equipment of the expedition had been studied, with special attention to the circumstances of an exceptional kind of campaign, and untrammelled by restrictions springing from the view that what had been done before might do again—it may be affirmed that no so carefully-provided-for expedition had ever left the shores of this or any other country."

Now let us turn to Cyprus. In July, 1878, a force equal to a strength of 2,276 disembarked at Cyprus. The hottest months of the year are July, August, and September. The temperature varied, from a maximum of 103° to a minimum of 85° F. There was a considerable fall at night. The mean temperature for July and August

was 73.5°, but 63° is at times recorded. The troops were at first encamped in bell tents, but afterwards in Sepoy pals on a sandy loam resting on limestone rocks. In December all the troops were quartered in huts.

The sickness, which showed an admission rate of 2.3 for the ten days after landing for the month of July, rose in August, September, and October until it reached a percentage admission rate of 48.8. Out of a strength of 894, from July 24th to December 31st, 1878, there were thirty-six deaths, twenty-two of which were from fever, and the sick rate was very high. The annual ratio of admissions and deaths of the force, calculated for the year 1878, was 4397.1 of the former, and 40.27 per 1,000 of the latter (death rate), and there was no fighting.

During the first six months of our occupation of Cyprus it proved, as will be seen therefore, very unhealthy from fevers attributable to the climate, to the hot season of the year, and the exposure to which the troops were subjected on first arrival. It is only right to add that the year might have been, and probably was, an exceptionally unhealthy one. The majority of the troops were encamped at Larnaca, but the 71st Highlanders, who were about 600 feet above the sea-level, were no better off as regards sickness.

From that time to the present, by hutting the troops and moving them to the uplands (Troados) 5,700 feet above the sea for the hot, and the plains for the cool season, their health has continued to be very good.

It is the fashion to allege that one man is as good as another, but he is nothing of the kind, and the experience of every day contradicts the allegation. Everything in a campaign depends upon a judicious selection of Medical Officers for certain posts; and the possession of certain qualities of character, such as good temper and good judgment, are as important as experience and a capacity for administration and organization. The Medical Officer in charge of a large base hospital requires, in addition to his professional qualifications, to possess all the qualities that would make him a good manager of a big hotel.

It would be an excellent plan for the Principal Medical Officer to collect together all those likely to occupy responsible posts, and explain to them beforehand the nature of the expedition and the proposed arrangements, so that everyone should be acquainted with the aim and object, the spirit and principles of the method of field medical operations, and the special arrangements made to fulfil the requirements of the expedition, as these existed in the mind of the Principal Medical Officer, with whom his staff should be *en rapport*, and not merely acting as parts of a mechanism, but as intelligent agents who had assimilated and practically appreciated the spirit and meaning of everything.

For the purpose of a campaign every Medical Officer should be provided with a *précis* of the field medical arrangements in a pocket form, a small almanack capable of being carried in a waistcoat pocket, a diary, and a carbon-book; the latter for making indents and for

writing short communications: one copy for the individual addressed, the duplicate being preserved as a record of the campaign.

On the occasion of the campaigns in Afghanistan I drew up a *précis* of the field medical arrangements, which was published under the sanction of the Government of India, and was binding on all departments. It was the Medical Officers' handbook, and was universally recognized as having been of great service. A similar document was published and issued to the Medical Service in the Suakim Expedition.

Medical Officers embarking in ships carrying any medical or surgical stores should see these embarked, and be in a position, on disembarking, to hand in their lists and to state where the material was. And it is very important, too, that Medical Officers who are to hold responsible posts of a purely professional—that is, of a medical and surgical—kind, should know exactly what surgical appliances and drugs would be forthcoming, and possess clear, definite, and practicable ideas, as well as a knowledge of how they proposed to carry out those ideas under the circumstances of any given expedition. This would ensure something like uniformity of system on an efficient and working basis, and guard against a tendency, on the one hand, to run into any great variety or multiplicity of drugs where a few simple agents would suffice, and, on the other, check the tendency occasionally exhibited to “runs” on particular drugs, by which the supply becomes exhausted, and unnecessary delays and consequent complaints occur.

The most important step towards attaining a successful field medical administration is the organization of a base. Our system of field hospitals may be represented by a closed telescope, from which you can project, as it were, the separate joints, each representing one or more hospital units or their equivalents, all capable of temporary self-existence and isolation, but still mutually connected and interdependent one on the other for supplies of men and material to the front and transit of sick and wounded to the rear. It is towards the base the sick and wounded will necessarily gravitate, and it is there that there should be ample supplies of everything. There is no reason why the sick and wounded should not be as well off and as comfortable in a base hospital as they would be in a station hospital at home.

The hospital accommodation provided at any base, or temporary base, would probably require to be to the field in the proportion of at least two to one; that is, assuming 15 per cent. sick accommodation, 5 per cent. should be in the field and 10 per cent. in base hospitals. Of course the proportion must, like the extent of the provision, depend upon the nature of the climate and operations.

In the Afghan War, for example, it was 7 per cent. at the base, supplemented by the cantonment hospitals, and 5 per cent. in front during the cold weather; but in summer, when the transport of the sick and wounded through the Khyber could not be carried on, it was 10 per cent. in the front and 2 per cent. at the base, by a transference of the balance of stores, &c., from one set of hospitals to the other.

It is, of course, of the very first importance that every Officer and man—every civil servant and employé—should be inspected before embarking on an expedition, and the rule should be absolute as to the rejection of those not physically fit.

We do not strive sufficiently in times of peace to attain the highest practicable efficiency in war.

There are no field hospitals organized and working as complete and independent hospital units at our camps and garrisons ready to take the field with their existing establishments.

Were it otherwise, and were these field hospitals practised on every available occasion, it should be easy, on the mobilization of troops for active service, to attach transport from the general transport of the Army, together with a certain proportion of a bearer company, and allow the whole to embark as a field hospital unit. In this way Officers and men who had worked together in times of peace would maintain the same relations in war, harmonious and effective working would be secured, and the competition between one field hospital and another would excite emulation in all.

I understand that in the new edition of the "Queen's Regulations" the Principal Medical Officer is not mentioned as belonging to the Staff of the Army. It certainly seems to me that he should be; that he should always have access to, and be in close communication with, the General Officer Commanding. For instance, the Principal Medical Officer has the statistical Returns of the health of the force. It is easy to calculate the percentage of sick to strength, but the total amount of sickness will give little or no information compared with that afforded by the nature and quality of the sickness. It is the tendency of certain diseases to go on increasing in a geometrical ratio if the conditions are favourable and cannot be modified; and it is easy to estimate, with sufficient accuracy to afford a working basis, what amount of loss the force may be expected to sustain in a given time. Surely it is of importance for the General to have this information, and to have it confidentially. There are many other considerations, too, which will occur to your minds why the Principal Medical Officer should be on the General's staff.

London is the centre to which all gravitate, and the Army requires to have its medical school there, and not at Netley.

With the number of hospitals in the metropolis, the extent and variety of injuries and diseases of all kinds to be seen there, London affords an amount of medical and surgical experience and practical information procurable nowhere else. It is not going through a course at a special military hospital or school that the Medical Officer requires on returning from foreign service, but opportunities for studying and keeping himself abreast with advances in knowledge and treatment. If facilities were granted to even a limited number of men, the privilege being guarded against abuse in any way deemed requisite, we should have Medical Officers proceeding to the highest qualifications in medicine and surgery. These would constitute the pick of the Service, and represent the "p.s.c." section of it.

It is in the Medical Service, as in other mundane matters, very much a question of rewards and punishments.

Power in this respect, after all, mainly rests with the military authorities, and it is not rarely a subject of regret that the hard hospital work of a very skilful man, or the arduous work of a Medical Officer at a base hospital, upon whom, perhaps, there focussed a larger amount of responsible labour than upon anybody else, are unnoticed and unrewarded, whilst those of another and inferior man, who has had the good luck to get to the fighting front and attract the notice of a General, meet with a recompense to which his real merits and professional attainments would not, in the opinion of his own branch of the Service at any rate, entitle him.

It has long ago been well said that, in addition to running equal risks with his brother Officers in the field of action and during a siege, the Medical Officer—"In performing the duty of hospitals is always exposed to dangers, even formidable dangers, from the contagion of disease; but glory does not attend such dangers; they bring no dazzling trophy; they are not encountered to destroy a foe, but to save a friend. The effect does not stand prominent in the public eye; it possesses no brilliancy and no general attraction; its reward consists in a satisfaction of mind, private but pure."

Pardon my introducing an incident here. A young Medical Officer, not long after he had married, was ordered out to the Cape. He joined the Headquarters, 94th Regiment, in the last Boer war, when it was surprised by the enemy, and ignorant of the fact that war had been proclaimed. Out of a total strength of 264, 156 were killed or wounded, and of 8 Officers 6 were killed, or speedily died of their wounds. Of the two survivors one was Captain Hume, of the Connaught Rangers, who was badly wounded and very ill; the other was the Medical Officer, himself suffering from a gunshot wound of the left thigh; and on him, single-handed, devolved all the anxiety, work, and responsibility of the position. He was a prisoner of the Boers for three months, during which he was half-starved. After he was released by the Boers he was so emaciated and aged in appearance that his own wife hardly knew him. In consequence of the hardships he then underwent his eyesight became affected, the remote effect of which was nearly total blindness, as much the result of his war service and devotion as if he had been shot in the eyes by the enemy.

It will be seen that there are a great many points affecting the relations of a medical service to modern war on which I have not even touched. There is a great deal one would like to say about transport, tentage, sanitation, the nature and character of food supplies, the use of concentrated medicines and the simplification and reduction of medical stores in the field, having a very direct bearing upon the subject of a medical service in modern war. It is very much to be desired that information in regard to the whole subject should be more widely diffused than it is; for it concerns everybody, as there are few families and households—rich or poor—that have not some one member or individual connected with the Army; and what is,

best for the public is best for the Medical Service, and the more consideration and criticism that can be brought to bear upon it the better for all concerned—especially for the doctors.

I allude to such questions as the soundness or otherwise of the principles on which the present system is based, in view of securing the simplest, most effective and economical organization, and of allowing room at the same time for the progressive improvement and development of the Medical Service as a whole, and of the Medical Officers composing it, in general and professional culture and practical knowledge, befitting members of a scientific branch of the Service, who may be called upon at any moment to apply their science to practical ends under circumstances demanding sound knowledge, good judgment, and prompt action; and the consideration of the limits within which the expectations and requirements of the public are reasonable and just, and capable of being practically met and provided.

These are questions that do not admit of being discussed within the limits of the present lecture. There is not a doctor worth his salt, in or out of the public service, for it is, so to speak, with them a matter of professional instinct, who does not think that you cannot do too much for the comfort and well-being of a sick and wounded man; still, war is war, and after the best has been done, it means a certain amount of hardship, and sometimes a large amount. The more rapidly executed the campaign, the greater is the saving of life, but this saving must often be purchased by the substitutionary sacrifice of the individual; prompt action and rapid movement are inconsistent with the transport of heavy equipment and supplies, and the greater the military success in this direction the harder is the task imposed upon all departments.

There is no finality about anything; there is room, no doubt, for developing and improving our methods of dealing with the sick and wounded in war; nothing in this respect is absolute, it is only relative; but the British public may, in the meantime, rest upon assured results, and take comfort in the fact that, looking to those obtained in all the wars that have taken place since the Crimea, the losses from disease and wounds have grown less and less, the success attained has been superior, and occasionally very far superior, to that of the medical services of other nations in their wars, and—the adverse criticism of non-technical, uneducated persons to the contrary notwithstanding—it has still remained for England to beat the record in this, that in her Egyptian campaigns from 1882 onwards she has succeeded, for the first time in the annals of war, in banishing all infective wound disease (the scourge of war hospitals) from our military hospitals; she has also succeeded in stripping her small battle-fields of their wounded, in transporting them to hospitals and hospital ships in the rear, with more ease and comfort and in a shorter time than other nations have done; her hospital ships have been the best designed, equipped, and provided of any nation in the world—from that of the “Victor Emmanuel” in the Ashanti War to the present time; and that in Egypt in 1882, when the Principal

Medical Officer of the force had letters from every country in Europe, from men (medical and lay), each prescribing his own specific remedy for the treatment of the ophthalmia prevailing among the troops, and generally adding, by way of consolation, that if such and such measures were not adopted the army would probably become blind in a month, not a single soldier lost his sight from a disease which proved so disastrous in the experience of the three armies in Egypt in 1801.

Inspector-General of Hospitals LAWSON: As perhaps the oldest medical Officer of the Army here present, I venture to propose that we should give a very cordial vote of thanks to Dr. Marston for the admirable paper he has read. As he has said, it would be quite impossible to meet the many points involved in the connection of the Medical Department with the troops in a single lecture. Every medical Officer who has had any experience will be aware of this, and it is no use my taking up the time to do more than express my agreement with the lecture. It is now a long time since I retired from the Army; therefore I had better leave it open for such gentlemen as have had a more recent acquaintance with the subject to put before you the result of their experience.

Sir THOMAS CRAWFORD, M.D., LL.D., K.C.B.: It was not my intention to say anything this evening with regard to the address of my old friend and colleague, and for one obvious reason—the greater part of his experience has been gained during a period when we were very closely associated together. It would almost necessarily follow, therefore, that anything I should have to say would run very much on the lines that Dr. Marston has taken in his paper. I think we are very much indebted to the lecturer for giving us his sketchy view of the subject, because after all a lecture could not be much more than a sketch of the many important points which both the medical and military authorities should consider before they send an army into the field. I am not quite sure that I agree with my friend, although I know—if I may use the term—that it is rather a fad of his, that he does not like any Regulations. I do not see how we can lay down principles which will guide those who have to administer the affairs of an army taking the field, unless in times of peace we carefully consider the subject and embody the results of such consideration in Regulations. I plead guilty to having advocated that view of the matter during my administration of the Medical Department, and having attempted to realize much of what Dr. Marston has pointed out as being so essential by giving information in the Regulations as far as it seemed possible to do so. I might mention one ground for adopting this course, which he has himself alluded to, that a medical Officer should always know what means are at his disposal for dealing with sick and wounded who will pass through his hands. We have tried by laying down careful equipment for almost every unit of military taking the field, and by stating what it is to consist of, to give that information to every medical Officer, and I think if the present Director-General were here he would tell you that at the present moment the Regulations contain a large amount of the information which Dr. Marston very justly demands for every medical Officer taking the field. There are one or two points in the address in which I take special interest, and which as they do not form an element in the Medical Administration of the Army, I might, perhaps, be permitted to allude to. I specially refer to the recent efforts that have been made, and I think I may say earnestly and wisely made, by our Volunteer medical brethren to cultivate amongst all classes of that force, and indeed amongst the public at large, some knowledge regarding the proper way of dealing with wounded or injured persons. This is not only valuable to the Army, and in the Army I hope that we fairly provide for it, but it is also valuable to the public at large, and although the movement may perhaps be carried to an exaggerated extent, too much in reality cannot be done in this direction which this movement—fostered and cherished largely by some of our Volunteer brethren—has taken. What Dr. Marston has said with regard to the impossibility of teaching men surgery in a few lessons is not only very true but it is a most important

truth; and in all our efforts to organize bearer companies and other subsidiary assistance of that sort, we should never forget the necessity of having the wounded men dealt with by well-trained Surgeons. No others are competent to deal with the wounded in the field, and if this country cannot afford sufficient medical Officers to do all the surgical work of its forces in the field, the sooner it ceases to send armies into the field the better. I do not think any bearer or any untrained hospital servant should be permitted to deal with the wounds of any soldier whatever. A sufficient number of medical Officers should be in the front under all circumstances to deal with these things themselves; the necessary assistance would then be given by bearer companies to remove safely and carefully the wounded to hospitals, where they must be finally dealt with. No other system, in my opinion, is justifiable; on the part of this country at all events. Dr. Marston has made a remark which might, perhaps, if left unexplained, reflect somewhat on my own administration. I trust, therefore, he will excuse me if I refer to it for a moment, that is, the organization of field hospitals at home in time of peace. The subject has not been lost sight of: it was carefully discussed on many occasions, even in my predecessor's time, and I had it repeatedly under my own consideration during the time I was Director-General. The difficulty is this: At home the Army will not be satisfied without a thoroughly well-equipped hospital, and this climate hardly admits of light camp hospitals being used under any circumstances. Indeed, in our camps in this country the arrangements are more like what they obtain in India in times of peace—military cantonments rather than camps. We have no regular field hospitals in our camps,—except perhaps a few formed for practice with moving columns in the summer,—that would give the Medical Department any opportunity of practising field hospitals in the manner in which they must necessarily use them during war. But I do think that all our camps at home should be organized so that, as far as possible, the practice in war should be applied to them. Our hospital organization at Aldershot, for example, where we have four or five brigades of troops, and where the Army is to be increased to a still greater extent, might be so arranged that each brigade should have its field hospital and personnel, although the hospitals, being permanent, might be more fully equipped than is contemplated in the case of active service. There is an excellent, well arranged general hospital on the spot, and the machinery which is worked in war should be applied to the working of these hospitals. I see no reason why this principle should not be adopted at all our large camps in Great Britain and Ireland; and I hope the Director-General will be able to take advantage of the rearrangement of the Aldershot Camp, which is to be taken in hand, to provide a field hospital for every brigade, and to organize and practise every medical unit laid down in the Regulations, including a general hospital, which will act as a base hospital, so that this system which Dr. Marston lays stress upon, and in which I fully concur, may be thoroughly matured. There are several points of considerable interest in the lecture, but I am afraid I must not trespass upon your time by calling attention to them. There is considerable stress laid by the lecturer upon the tendency of the present military administration to give any little countenance, and especially anything in the way of rewards, rather to the men who are in the front than to the men who are in the rear. I am afraid that must always be the case in war. It is human nature to attach the greater importance to the point that the public recognize as the dangerous one, and the men in front will therefore probably always come in for those acknowledgments which are commonly distributed after successful operations in the field; but I am well aware that no General Officer in the field at the present day ever sends in his despatches without consulting the Principal Medical Officer, and that the Principal Medical Officer in every army which has taken the field,—at all events during the time I have had any knowledge of the administration of the Medical Department—has had an opportunity of bringing to notice any man he thinks worthy of notice, whether it be in the base hospital or in the front. He has also the opportunity of putting a bar against any man whose name may be put forward even by the General for acknowledgment, if he thinks that the man is not worthy of it. I think, therefore, if unworthy men are rewarded, and thoroughly worthy men are passed over without reward, we must consider the fault our own and not the fault of the system. A remark with refer-

ence to the Principal Medical Officer in the field requires some little explanation. Dr. Marston says that he is to be no longer on the staff of the General Officer. The Army Corps tables proposed before I retired from the Service provided for a complete staff for an Army Corps as the unit, and every Army Corps has a Principal Medical Officer on its staff, and he is necessarily with the General Officer Commanding the Army Corps. But when more than one Army Corps is in the field, or when two or three Army Corps are employed under a General Officer in chief, then there is a Principal Medical Officer in chief also appointed to that army; but he, like the Quartermaster-General, is relegated to the position in which he may be supposed to be most useful, that is, in the rear and on the line of communication, where the Quartermaster-General, who is charged with the duties of supply and transport, and the heads of the other public departments of the Army are also stationed. These Officers are, I believe, in the future to be associated; but they are by no means out off from communication with the General in chief, and every information that they can give, it is obviously their duty to lay before him. The general duties which Dr. Marston properly enumerates as belonging to the Principal Medical Officer are more legitimately the functions of the Surgeon-General of each Army Corps, who is with the General Officer of the Army Corps, and who, subject to the approval of the General in chief, will deal with all those sanitary questions and all those questions of the efficiency of corps and other points which Dr. Marston has laid stress upon, and which are so necessary to be attended to. I thoroughly agree with almost everything that Dr. Marston has said; and in calling your attention to these few points, I by no means wish to criticize the views that he has put forward here. I agree entirely with my friend Inspector-General Lawson that Dr. Marston is well worthy of the thanks of the Institution for the lecture he has given us.

General Sir ROBERT HUME: I think, Sir, as a combatant Officer, one ought to make some observations on the paper, because of course there must be two sides to every question, and while agreeing generally with what the lecturer has said, there are one or two points that, from another point of view, I do not exactly agree with. The first is as to the Regulations. The natural thing would be that you have recourse to Regulations first, and then you would like to have a medical Officer who would recommend another course of procedure out of his own head, if he found the Regulations were not equal to the occasion. And I certainly think it always is the case that the Principal Medical Officer is actually a Staff Officer, and is always in consultation with the head of any force, either in cantonments or in the field, and if the General Officer Commanding is not in constant and confidential communication with the chief medical Officer wherever he may be, the result must be very disastrous. It was always the same in the old time, when the regimental system was in force, as long ago as the Crimea, where the principal medical Officer of a regiment (the Surgeon of the regiment) and the Colonel of the regiment worked together as they almost always did, but sometimes there were cases where they did not, and where they did not work cordially together the results were invariably most disastrous. And so it will be at the present time. I am sure that the first care of any General Officer in any position would be to be on the most confidential terms with his Principal Medical Officer, and I know this, that all through the Service those are the feelings that animate all ranks of Officers, of any length of service, at all events, because we know how much the good of those under our command depends upon the cordial working together of the medical Officers and ourselves, and there is no one who has served for any time who is not aware of the great obligations that the whole of the combatant Army are under to the medical service. There is one thing that struck me very much, especially during my Indian service, that in many cases, as I know personally, medical Officers, both high in the Service and of short service, who have come home ill, have spent their time at home, as soon as they were well enough, in working hard in London, so as to perfect themselves in all the improvements that have been going on in their profession while they have been out in India; I think that is very meritorious. It always struck me so. I am disappointed in the attendance not being larger to-day, because when I took up the list of lectures, I looked upon this as one of the most important if not the most important, subject on the list. I feel quite certain that all of u

who have listened to Dr. Marston's lecture will thank him most cordially for the care and trouble which he has taken in preparing it, and for the able manner in which he has laid the matter before us.

Sir JOSEPH FAYEE, M.D.: With your permission I should like to say a few words. First of all I desire to thank the Council of this Institution for inviting me to come here to-day. When I heard of the subject of the lecture, and who the lecturer was to be, I knew that I should hear a good address, and I have not been disappointed. I have known Dr. Marston for many years, and I have had the good fortune to be associated with him in public duties, so that I have had considerable opportunity of watching his career through that time, and knowing what ample opportunity he has had of gaining the information that he has so lucidly and clearly submitted to us this afternoon. I wish therefore to add my thanks to those which have been given already to Dr. Marston for his address, and I am glad, as an Indian medical Officer, to know that the admirable system of administration which now prevails in the British Army at home and elsewhere is extended to India. I have no desire to criticize, or to enter into any question of detail. Were I to do so, I think there are some points on which, perhaps, I might not agree with my friend, but I have never found any difficulty in getting on with those people with whom I did not happen to agree on certain scientific questions, for in fact if we did always agree, there would be little progress. I am quite certain no one could listen to Dr. Marston upon the present subject without feeling the greatest respect for what he says. I repeat, then, that I am glad to know that this system that he has referred to has been extended to India, and I rejoice to find that he has emphasized the importance of the medical service by showing what the results of its operations have been; how disease has been prevented and the death rate diminished by sanitary proceedings, which are under the guidance and administration of the Medical Department, and how the general comfort and well-being of the soldier and others connected with the Services have been enhanced. He has himself taken a large share in the proceedings, and of course they began before his time, but he has contributed greatly to their development, and so has my friend Sir Thomas Crawford, who has just addressed you. I hope this paper may be the precursor of future lectures upon a similar subject. I have noticed that many lectures are given upon purely military matters, but I have seldom, if ever, had the good fortune to hear of one upon medical questions connected with the Service being dealt with in this Institution. I sincerely trust that such lectures will be given in the future, and that the questions will be as plainly and explicitly treated as they have been to-day by Dr. Marston.

Sir WILLIAM MACCORMAC: I am afraid, being so much an outsider, I have but little to say, but as you have called upon me I should like to say this much. I think we are all indebted, and I myself personally feel much indebted, for the admirable lecture and the facts that this lecture has brought before us. I think Dr. Marston speaks with great authority on these matters. He has had the opportunity of practising what he preaches, and he has alluded to the results of some of that practice. I was in a position to know, soon after they occurred, two of the things that he mentioned just at the close of his lecture, how, as the result of the improved administration and good materials which were supplied to our Army in the field, results have been obtained in the Egyptian campaign which have never been before realized. It has been, as he said, quite unknown in the previous history of military surgery for a large number of wounded men to be brought together, and yet, amidst the aggregation of men, not to find one single instance of those fatal infective diseases which, until recently, we might say always, occurred not merely in the time of war, but in our civil hospitals. It is quite an unexampled thing—never before realized. The same might be said of the achievement which he adverted to of a number of men serving through a campaign in Egypt without experiencing any of those destructive affections of the eyes which brought blindness to so many of the soldiers that had served in Egypt before. There are, of course, many points in this lecture which one might perhaps advert to, and one occurs, namely, if it be possible at all that we should endeavour to realize what Dr. Marston urged with regard to giving an opportunity to medical Officers of the Army to—I may say so, I suppose, without any offence—rub the rust off by coming

to a centre such as London and availing themselves of the unrivalled opportunities which the great clinical field of material of this great city affords. It is necessary for every man to rub the rust off, and we ought to seek for an opportunity of rubbing it off daily, and we have to rub it off as hard as we can in order to keep abreast of the times : and no doubt Officers abroad, separated as they must necessarily be from sources of information, are not able, from the circumstances of the case, to keep themselves abreast of current knowledge ; and I am sure a great boon would thus be conferred upon a Service whose Officers are all anxious and willing to avail themselves of every opportunity of gaining information and experience. This, I am sure, will be a benefit to the public service of this country. I think I may say, from my own observation, and I think it is the opinion universally of others, that the medical service of our Army is improving, that it has improved, and that it is likely to go on improving, especially if means are taken to attract good men into it, and opportunities are given to those men to be contented and happy in the service in which they have elected to pass their lives. I am sure I would gladly, and do gladly, take this opportunity of adding my cordial thanks, whatever they may be worth, from a civilian point of view, to the lecturer for his admirable address. Of course he could not have covered the very large ground that his address takes in, but he has brought forward many interesting and many valuable points which I am sure are well worthy of our attention.

The CHAIRMAN : It is impossible in the time at our disposal to attempt to criticize in detail the various questions so clearly put before us in Dr. Marston's able address. Although the lecture deals, for the most part, with the principles upon which the medical department of the Army should be organized for field service, it also raises many important questions of detail which are well worthy of the consideration of this meeting and of the public. Take, for example, the question of field hospital equipment and transport. Sir Thomas Crawford tells us that full field equipment with transport has been, or is being, provided for the troops at Aldershot. Most of us would like to see the bulk of the garrisons in England similarly equipped, so that men and Officers should be thoroughly and regularly habituated to camp life. The cost of the arrangement would be considerable, but it would be money well spent, for the efficiency of the hospital service in war is just as essential to success as the efficiency of the combatant branches in the special training which alone fits them to take the field. The present hospital system works very well on the whole. The consolidated system has many advantages over the regimental system, but I venture to think that the complete withdrawal of the medical staff from regiments was a mistake, and was not essential to the establishment of the unified system. In that part of the Army with which I am best acquainted, it is found necessary in every garrison to detail a special medical Officer for the purpose of attending the emergent calls that may be made upon him by the regiment or battery for which he has been told off. The Officers so employed are not in touch with the Officers and men ; they are constantly being changed, and consequently the value of their services is not a tithe of what it would be if they were on the permanent staff of the regiments concerned. I believe that the appointment of a medical Officer to every regiment for a fixed period of from five to ten years would in no way interfere with the consolidated system, and need cause no extra expense. The point is not a new one ; it has often been raised before, and I hope that some day the authorities will see their way to adopting it, in the interests of military efficiency. Dr. Marston again observes that, in the new Queen's Regulations, the P.M.O. is not mentioned as belonging to the Staff of the Army. I must confess to not having had an opportunity of reading up the new Regulations, but I am sure of this, that a General Officer who is not in the closest and most intimate relation with his P.M.O. cannot be surprised if the medical arrangements are not as perfect as they might be. My own experience is that, if the head of an important department is not in the confidence of the General in command, it is absolutely impossible for him to carry on his duties efficiently. The lecturer again, very justly, observes that the Army medical Officer is exposed, not only to the ordinary risks of battle, but to the formidable danger of contagion from disease ; he shows that such dangers attract small public attention, and that the only reward they bring is "satisfaction of mind, private but pure." There is, I

regret to say, a great deal of truth in this picture. It is often said that the rewards given at the end of a campaign to the Officers of the medical and other departments are not in proportion to those granted to the combatant ranks. However this may be, I can assure you that, so far as my own knowledge of the matter goes, the responsibility for this result does not rest with those placed in independent commands in the field. My experience is that General Officers are always anxious to bring to notice the names of the departmental Officers who do creditable and meritorious work of any sort in time of war, and they make every effort to get the services of such Officers recognized and rewarded. There are many other points in the lecture which deserve thoughtful consideration, but it is not possible adequately to deal with them here, and it is now my pleasing duty to ask your hearty concurrence in the vote of thanks which it has been proposed to offer Dr. Marston for his very interesting and instructive address.

Dr. MARSTON: Sir Donald and gentlemen, I am very much obliged to you for this vote of thanks. I think the paper has been spoken of, altogether, in far too flattering a way. There are just one or two remarks I would like to make, and the first is that you quite understand there is no intention of attacking anybody. If several things have been already done or attempted in the directions indicated, I am extremely glad of it. The next thing is with regard to the regimental or other systems; it is a great deal too big a question to enter upon here. My lecture is exclusively upon the medical service in modern war, and in war you must have a medical Officer with each corps unit, plus your general medical staff, working field hospitals, &c. What I have said in regard to the Regulations refers more particularly to headquarters' work; for instance here in London. Of course you must have Regulations, but are we not over-regulated? If you want to carry out a thing promptly and well, it is of great importance that a man in a responsible position should be able to put his views in the space of a sheet of note-paper, and not have a lot of different departments cavilling or turning to Regulations or War Office Circulars, and so on. You need to be a lawyer to understand all these Regulations—and there are so many of them that they bury one another—you do not know where to find the particular one you want. I was never very good at it, and that, perhaps, has given me a dislike to it. As the result of my own experience, I have always found General Officers perfectly reasonable, always willing to aid me in every way if I had a good case and could make it plain to them, and I have never had any difficulty in that respect. As regards your remarks, Sir, about the understanding that should exist between the Principal Medical Officers and the General Officer, I have always heard that medical Officers were very desirous of serving under you, and I can well understand it.

Friday, March 14, 1890.

GENERAL SIR C. P. BEAUCHAMP WALKER, K.C.B.,
Vice-President, in the Chair.

THE SHOEING OF HORSES FOR MILITARY PURPOSES.

By GEORGE FLEMING, C.B., LL.D., F.R.C.V.S., Principal Veterinary Surgeon.

AN apology would appear to be almost necessary for now venturing to introduce such a subject as the shoeing of Army horses; inasmuch as it may seem to many to be of too trivial a character to merit notice among the many very important topics which should be, and are, brought here for observation and discussion. If any apology is needed, I would remind those who may imagine that such a matter as this is undeserving of the attention of all who desire, or who are occupied with the efficiency of the Army, that nothing in the way of details can be neglected in order to ensure thorough efficiency; and, in fact, that this rests entirely on details, the completing and perfecting of which must not be trifled with or ignored. Neglect of even one of them, and that perhaps apparently the most insignificant, may entail serious results, as the history of warfare amply testifies; and the immense importance of giving heed to every item upon which efficiency depends is well illustrated in the old Spanish proverb, which is pertinent to our subject: "Por un clavo se pierde una herradura, por una herradura un Cavallo, por un Cavallo un Cavallero." Or as Benjamin Franklin puts it: "For want of a nail the shoe was lost, for want of a shoe the horse was lost, and for want of a horse the rider was lost, being overtaken and slain by the enemy (another version adds that by the death of the horseman a city was lost); all for want of a little care about a horse-shoe nail."

But those who have had experience with mounted corps in the Field, will be ready to agree with me that the shoeing of Army horses is very far from being an unimportant or trifling matter, and that it sometimes makes itself a very prominent one, and one demanding much anxious care and attention. It is from this point of view that we shall to-day examine it; and I am hopeful that you will be able to arrive at the satisfactory conclusion, that among the many improvements which have been effected in recent years in the condition of the British Army as a fighting machine, the shoeing of horses may justly be included.

You will not expect a historical dissertation upon an art which, humble though it may appear, has yet had, indirectly, a vast influence

upon the destinies of mankind, in lending its aid to the restless wave of human action in the evolution of civilization. For it must be admitted that, without this humble handicraft, the value of horses would have been very small indeed; and the world without the full development of this animal's powers would have made but little progress.

The varied uses to which the horse has been subjected since taken from a wild state, and the willing and cheerful manner with which he has undergone fatigue—performing duties which are, one would think, quite foreign to his nature, have all been owing to his combined and unequalled qualities of strength, courage, speed, fidelity, and obedience; but though his great value depends essentially upon a just disposition of these, yet more especially is it as a living machine, capable of moving or producing motion, and communicating it to inert masses at all times and in nearly all situations, that he is to be prized.

The history of mankind abundantly testifies that every possible use has been made of the horse, whether in war, commerce, or pleasure; and the most ancient nations were as cognisant of his value as the most modern—proving the early sense and conviction of his importance. Those old-world nations which, long ages ago, most largely employed the horse, were the great centres of antique civilization; and it may be safely asserted that without him the human race could not have reached its present state of advancement and refinement, or have been able to contend against the numerous obstacles to the comfort and happiness which it now enjoys. Indeed, it has been said that next to the want of iron, the want of horses would have been perhaps one of the greatest physical barriers to the advancement of the arts of civilized life.

In the deployment of his good qualities, as a motor especially, the horse must rely upon the integrity of his feet in weight-sustaining and weight-propelling, and to maintain these parts strong and sound has been the object of horsemen from the earliest times—from the days of Xenophon—up to the present year. The aphorism of "No foot, no horse," was as obvious to ancient as to modern people, and unless his wonderfully constructed feet are maintained in a healthy condition, he is indeed valueless to man.

In a state of nature the hoof requires no protection, as its growth is sufficient to meet the demands of wear. And in certain parts of the world, the animal can even perform a fair amount of work without recourse to shoeing. But this is where the climate is dry and the soil soft and elastic, and where horses, firm and wiry in themselves, have dense, tough hoofs. Domestication and climate, no less than soil, have an immense influence on the hoof-horn; and horses brought from countries in which shoes can be dispensed with, to those which are moist and stony, or which have artificial roads, are no more exempted from the necessities for hoof protection than the animals native to these regions.

The necessity for preventing injury to horses' feet from undue wear of the hoofs must have presented itself at a very early period to

equestrian races, especially in unfavourable situations or humid climates; and though some kind of protection may have been introduced, yet it is only at a comparatively recent date that we find any mention of the present method of shoeing. True, some of the Roman writers allude to a kind of sandal made of sparteum, something like the horse-sandal of rice straw used by the Japanese until a few years ago; but there is no written evidence that an iron plate attached to the hoof by nails was known to either Greeks or Romans. Some years ago I was induced to undertake an investigation into the history of horse-shoeing, and the result, given in my work entitled "Horse-Shoes and Horse-Shoeing" (London, 1869), was that this art must be of great antiquity—probably extending beyond the Christian era, if the evidence afforded by a coin of Tarentum can be accepted.

Shoes of iron and bronze have been found with Gaulish remains at Alesia and elsewhere on the Continent of Europe; and in this country they have been discovered with Celtic and Roman articles which clearly indicate their remote age, and go to prove that among the Gauls and ancient Britons, horses were shod in much the same way as they are now-a-days.

These shoes, no matter from what source they were obtained, I noticed were small, indicating that the horses of those days were not much larger than ponies or small arabs; they are remarkably uniform in shape, being narrow and light; on each branch there is a calk, and a peculiar and typical feature is their undulating outer border, due to the three large cavities on each side intended to receive the base of the immense nail-heads, which projected for some distance above the level of the shoe. These nail-heads and the calkins secured a good foothold for the animal; and, altogether, the horse-men of that time had a better notion of shoeing, and of preventing horses slipping, than would appear to be the case now-a-days.

It is probable that shoeing was introduced, or first practised, by the Gauls, and that their priests, or Druids, were the shoers and armourers. The strange superstitions which still attach to horse-shoes, and the legends connected with them, and the *faber ferrarius*—Wayland Smith and other mythical personages of Northern and Western Nations—would point to this. In Wales, long before the Norman invasion, the shoer was an important personage at Court, and enjoyed great privileges because of the importance of his art; and at the French and German Courts he was a high noble, with a designation from which is derived the title of Marshal. In France at the present day the shoer is still known as the *Maréchal ferrant*; in this country the names of Marshal and Ferrers are significant of horse-shoers; while horse-shoes formed Coats of Arms of families and Corporations, and during the Middle Ages the art of shoeing appears to have occupied a very elevated position indeed.

The simple but sensible shoeing of the pre-Norman times was followed by a more complicated and clumsy style with the introduction of large horses, clad, like their riders, in heavy armour; and when the anatomy of the animal began to be studied in the 17th and 18th centuries, extraordinary notions began to prevail with regard

to the functions of his feet—notions which, carried into practical effect, have been the cause of serious injury, even up to the present day.

It is needless to mention that, in early times, shoeing was chiefly resorted to for military horses; oxen, mules, and asses being mainly employed for draught and agricultural purposes in civil life.

Mistaken ideas as to the functions of the foot, and especially of its protection—the hoof, led to the latter being considered as something inimical to the animal's welfare; it was therefore barbarously mutilated, and only too often is so yet outside our Army; while the shoe attached to it was clumsy and damaging in the extreme.

The sole was unmercifully cut away until the blood was sometimes oozing through the horn, the frog—considered too sensitive to come into contact with the ground, and being soft and easy to incise, was artistically carved to please the fancy of the shoer, or the horse-owner or groom; while the wall, the most essential portion of the hoof, was perforated by far too many nails, and rasped and beautified until there was frequently little of it left to which the shoe could be fastened. The shoe itself was made to correspond with the fantastic and utterly erroneous ideas prevalent with regard to the physiology of the foot. It had to be made heavy and broad in order to cover the tender sole, and as this could not bear any pressure from the shoe after being denuded of its natural protection, the horse's weight had to be supported on the margin of the hoof. Consequently, there was a space between the shoe and the sole, while the ground surface of the shoe itself, being wide and plane, was well adapted for slipping. This narrow bearing of the shoe on the foot, the space between it and the sole, and the cumbersome weight of the shoe itself, necessitated a great number of nails to keep it firm on the hoof—a result seldom attained, especially in heavy ground, where the suction readily tore it off, and with it generally a large portion of the wall.

The shoer's art was overdone, and to shoe a horse whose hoofs had undergone such barbarous treatment at his hands required a great amount of skill and time; and even then the animal was only too often crippled by nails driven too near or into the quick, or by the shoes being fastened too tight on the morbidly sensitive foot.

For some years a much more rational system of managing the hoof has prevailed in the Army, owing to the shoeing being placed under the superintendence of the veterinary officers, who had not the ignorant prejudices of grooms and others to contend with, as had their colleagues in civil life. The excessive mutilation alluded to was not allowed, and the hoof-horn was looked upon as the natural protection of the foot, not as something alien to it and which must be cut away.

But until six or seven years ago, the Army horse-shoe was still faulty in shape, in being plane on the ground surface, and bevelled on that next the sole; so that the weight of the animal was borne on the margin of the hoof only, a cavity existing between the sole and shoe; consequently, the foothold was very insecure, and the connection between shoe and hoof was comparatively slight, especially on heavy ground. And until the last three years, the farriery arrange-

ments of the Army were faulty in the extreme, and quite unsuitable to meet the demands of war service—indeed, they scarcely sufficed for the requirements of peace. The shoers for very many years contracted with the Government to shoe the horses, receiving a certain sum—latterly a halfpenny a day for each horse; this in itself was bad, as it led to abuses. For this sum the shoer provided the shoes, nails, and tools; and as he had to make the two former, it took all the time of the sergeant farrier and shoeing-smith to keep a troop of cavalry horses—about forty—tolerably shod. A man required generally about three years' training before he could make shoes and nails, and shoe a horse fairly well; but it must be confessed that the shoeing was often very unsatisfactory, and it was impossible to obtain anything like uniformity. Not only this, but after men had been carefully trained, they not unfrequently took their discharge, as such occupation in civil life offered better prospects than the Army did.

Owing to the long time required to teach shoers, there were very few men in cavalry regiments, beyond those actually employed in the forges, who could shoe; in fact, it was sometimes very difficult to keep up the number necessary to maintain the horses in an effective state in peace-time. Consequently, there was no provision for war, and in the Crimea—which was a vast standing camp, with no marching—the trained shoers were soon expended, and had to be replaced by the waifs and refuse of the civilian forges. It is not easy to realize the condition our mounted forces would have been in, had there been any marching.

The introduction of short service rendered matters still worse, as there was not then sufficient time to properly train even the number of shoers needed for peace requirements—the demands of drill and other branches of a soldier's instruction making a serious inroad upon the comparatively brief period men were engaged for.

The unfortunate state of the farriery organization existing at that time was well exemplified in the Egyptian Campaign of 1882. The cavalry regiments were sent from this country with the ordinary complement of farriers for the actual requirements of each troop, scarcely any being in reserve. The marching was trifling and the campaign brief; yet at the end of a month, one regiment—the 7th Dragoon Guards, which had left England with seventeen farriers—was telegraphing home for more to be sent out at once, as the number was nearly expended, and the horses could not be shod. Unluckily, the regiments at home had no farriers to spare, so none could be sent to Egypt without causing these to be short of their complement. Not only was this want of shoers experienced in the cavalry, but the other mounted branches were little better off; while the Regimental Transport horses in Egypt were in a sorry plight. It was reported that many of these returned to England, after several months' absence, wearing the same shoes which they had on their feet at their departure, and which had never been removed. The Principal Veterinary Surgeon of the expedition stated, that "Infantry Regiments, being unprovided with shoeing-smiths, their Transport horses and mules were constantly left unshod, except when a man from the Commissariat or one of the mounted corps could be obtained. The

feet of the animals were therefore very frequently in a bad state." It was very fortunate that there was little marching, or the results might have been something akin to disastrous.

That campaign demonstrated, in a most unmistakable manner, the urgent need there was for amending or reorganizing the farriery system of the Army, so as to enable it to meet the altered circumstances of the times; and this task was the first imposed upon me on becoming Chief of the Veterinary Department. In my Annual Report for 1886, the scheme of reorganization I had proposed in 1883 is alluded to in the following terms:—

"It has for many years been evident that the system of farriery existing in the Army had become obsolete, and could no longer meet the demands even of peace service. In the field it always broke down in a few weeks, and then there was the greatest difficulty in keeping horses shod—a difficulty which was only partially met by engaging large numbers of civilian farriers, as during the Crimean War (men who were of little use, being the refuse of the shoeing forges of large towns); or by denuding the mounted corps at home of their farriers, which occurred only so late as in the Egyptian campaign of 1882. The introduction of short service into the Army made the defects of the system all the more evident.

"During the long-service period, when men served for many years, there was ample time to train farriers to make horse-shoes and nails, and to shoe horses; though even then it was impossible to secure uniformity in shoeing throughout the Army, it being good in some corps and sometimes very bad in others. And it generally required at least three years to teach a fairly intelligent man to become a good artizan; so that in each troop of cavalry, in addition to the sergeant farrier and shoeing-smith, there was always a man in training, being three men to shoe about forty horses. Owing to this large proportion of men, much trouble was often experienced in obtaining soldiers for training, and especially as the shoe- and nail-making, together with the shoeing of the horses, occupied nearly all the time of the farriers, and left scarcely any for other regimental duties. Hence, as a rule, there were no spare shoers in the ranks; and on active service, the farriers being in the fighting line and exposed to all the risks of the other soldiers, *plus* the fatigue of shoeing the horses while their comrades were resting, they were the first to succumb, and there were no others to replace them.

"With the introduction of short service, it was found impossible to allow three years to be devoted to training in farriery, when so much of the brief period had to be spent in drill and other instruction necessary for men of mounted corps; so that for some time there was the gravest difficulty in keeping the horses shod at all when in barracks, while there was an utter breakdown in Egypt in 1882, though the campaign was very short, and there was but little marching.

"To remedy this serious state of affairs, it had been suggested that there should be a special corps of farriers formed, and that men from this should be attached to regiments. But a very brief consideration sufficed to show that this proposal would meet with the strongest

objections, not the least of which would be the heavy expense it would entail; and, besides, when carried into execution it would lead to dissatisfaction, and fail to meet all requirements."

The introduction of machine-made horse-shoes and nails a few years ago fortunately enabled me to devise another plan, which has none of the disadvantages and objections that would attend the institution of a Farriers' Corps, and which, while allowing us to provide a large and sufficient number of shoers in corps to meet the demands of war, simplifies and improves the art of shoeing, ensures uniformity throughout the Service, allows of more men for regimental duty, and increases the efficiency of the horses while at work, by affording them a better foothold (owing to a new pattern of shoe), at the same time maintaining their hoofs in a strong healthy condition.

This reorganization consists—

1. In abolishing shoe- and nail-making to the extent of three-fourths of the supply required, the remaining fourth being made by the farriers merely in order to keep them in practice; the three-fourths to be machine-made shoes and nails, all ready for immediate use. In recommending the discontinuance of shoe- and nail-making in the Army, I was only acting on the knowledge which everyone who has had experience of field service in mounted corps is possessed of: that it is impossible during a campaign to make shoes and nails, and that it is generally a matter for congratulation if the horses can be kept effectively shod when these articles are provided for the farriers. The absurdity of sending iron and coal into the field with which to make horse-shoes will be apparent, when it is stated that it requires 15 lbs. of coal and about 6 lbs. of iron to make a set of shoes which, when ready to be put on the horse's feet, will weigh only about 5 lbs. Then the manufacture of shoes in the field necessitates a lumbering field-forge with its heavy tools, drawn by two, four, or even six horses (as in Egypt, though that number was not always sufficient, as some of the forge wagons were left behind imbedded in the sand); and lastly, there is the time, the men, and the labour required to make the shoes. If it is highly inconvenient or impossible to make shoes on active service, then, even if short service allowed it, it must appear a waste of time and trouble to attempt to teach men to do this during peace, if all instruction of soldiers should be with a view to their effectiveness in war.
2. In having a number of men in the ranks taught to *put on* shoes as on active service, the number to be at least 10 per cent. in mounted corps; besides the sergeant farrier, and a reduced number of shoeing-smiths in training for the grade of sergeant farrier. This number of men will afford a good reserve of shoers, and as any man of ordinary intelligence can be taught to shoe sufficiently well in about three months, there ought to be no difficulty in keeping up the percentage.

3. In the sergeant farrier, instead of wasting his time, as formerly, in shoe-making, being now an instructor of men in shoeing horses with ready-made shoes; while at the same time, having been specially trained at the Army Veterinary School, he can join a Field Veterinary Hospital Staff at brief notice, without causing any inconvenience to his regiment, as the shoeing can be carried on independent of him. The men, when trained to put on shoes, return to the ranks until the 10 per cent. are taught, when they come back to the forge, in turn, for a certain period, to shoe the horses, and thus keep up their practice.
4. In having two men per battalion of Infantry, and a certain number of Marines, taught to shoe horses. The necessity for this measure is evident, as the requirements of Mounted Infantry and regimental transport have hitherto had to be met, when possible, by lending them Cavalry or Artillery farriers. But sometimes these could not be spared, and then the horses were left uncared for, so far as shoeing was concerned.

Official sanction to the proposed scheme had been anticipated, and instruction was commenced some time ago, and is now carried on as energetically as possible.

The machine-made shoes are so well-shaped and finished, and are made of such excellent iron, while the nails are so perfect and easily driven, that the labour of shoeing is immensely lightened and shortened, and men are soon taught. A moderately expert man can shoe a horse in half-an-hour, and it has been done in less than twenty minutes. On this system, and during an emergency, a shoer might easily keep 150 horses shod all the year round.

Another feature of the reorganization is the abolition of the contract system formerly existing between the Government and the farriers. This had for long worked badly, and its cessation will be advantageous to the public. I have estimated that, in the matter of cost alone, the adoption of the proposed system will effect a saving, in the Cavalry only, of about 4,000*l.* annually. But the problem of a farriery organization which will give a large number of skilled Veterinary Hospital assistants, and a supply of shoers sufficient to meet the demands of mounted corps and infantry during a long campaign, will, I hope, be solved when the scheme is fairly in operation. And even did it cost more, instead of less than the late most defective system, this would be as nothing when compared with the benefits which will certainly be derived from it, especially on active service.

The question of mobility has not been overlooked in considering the subject of farriery. I had suggested that, for cavalry, the heavy forge and forge-wagon should be dispensed with, and a small portable forge (weighing about 200 lbs.) be issued instead, one of these to each wing of a regiment. This forge can be carried on a pack-saddle and will meet all the needs of the shoers; indeed, with the new form of shoe a forge will rarely be required, as nearly all alterations in shape

can be effected without heating it. The experience gained in the expeditions to Suakin and Bechuanaland testifies to this.

The introduction into every-day service of shoes and nails ready for immediate use has another advantage which must not be overlooked. On every campaign since I entered the Army, serious complaints have been made as to the manner in which the Store Department issued these articles; sometimes they were deficient in supply, but more frequently, perhaps, they were issued in wrong sizes to corps, and there was generally delay and confusion; while occasionally the pattern, or the material of which the shoes or nails were made, was very defective. These faults were owing, in great measure, to store-keepers being unaccustomed to issue such articles in peace-time, and being therefore unacquainted with them; and to the shoes and nails being kept in store without being properly examined or tested before they were sent into the field.

By the constant issue of horse-shoes and nails from store in ordinary times, the issuers will be experienced in this important duty; while the pattern and material of the articles will be always under trial, and necessary improvements can be effected as the trial progresses.

Such was the reorganization I proposed, and I am pleased to say that, after ample trial, it was adopted, and came into operation for the whole of the cavalry in this country in April, 1888. It is now being tried in some batteries of artillery, with a view to its adoption in that arm, and it is also undergoing trial in the Army Service Corps and Royal Engineers; while it is altogether practised in infantry transport.

This "cold system" of shoeing, as it is termed, in contradistinction to making shoes and fitting them to the hoof while hot, has proved a great success on active service. In the Report of the Principal Veterinary Surgeon with the Suakin Field Force in 1885, we find the following allusion to it: "The horses and mules were kept fairly well shod up during the campaign, and the shoeing was, on the whole, good." "The system of 'cold-fitting' was, on my recommendation, generally adopted, and the new pattern machine-made shoes and nails were used, as far as was practicable, especially among the lighter horses. The superiority of these shoes over those of the old pattern has already been clearly demonstrated by the late experiments in the United Kingdom, but I believe this is their first trial on active service. Their principal advantages appear to be:—1. The ease and celerity with which they can be fitted cold; 2. The superior quality of the iron; 3. Their lightness, durability, and finish; 4. The fact that the heavy field forge, with the fuel and plant for shoe-making, can be dispensed with—the small pack forge being merely necessary in the few cases where heat is required. The immense advantages of the latter, especially in a campaign in the desert, where wheel-transport is impossible, can readily be understood."

Quite recently the Inniskilling Dragoons severely tested the system while on active service in Zululand, and the following extracts are made from the report of the Officer Commanding that regiment.

He says: "The regiment having been on field service in Zululand during the last six months, the new regulations as regards cold-shoeing could not be carried out in every particular; though, as far as was practicable and possible, every effort has been made to act on and carry out the instructions issued. Shoeing the horses with cold shoes has been done most fully, and I think very successfully. . .

. . . In a standing camp there can be but little difficulty about the details of the system being carried out in their entirety. The material of the shoes is excellent, and if they are gently heated by slight blows from the hammer, they can be opened out or otherwise altered in shape, so as to fit the foot without injuring the shoe; though if they are opened out before being treated as above, they nearly always break at the toe. This arises from want of care on the part of the farriers, and will always be the case unless caution is exercised. . . . The nails are of good quality, well-made, and carefully finished.

"Owing to the regiment being in detachments, and constantly on the move from one place to the other, the horses were all shod with the ready-made shoes and nails supplied for the cold-shoeing, none being shod with the hand-made shoes and nails; as it was an impossibility, under the circumstances, to make them. . . . The shoes and nails are durable and last well.

"The conditions of service under which these shoes were used were exceptional, as the troops were on field service during the whole period. The shoes, therefore, were tried under severe conditions, and I consider that they bore the trial satisfactorily."

I may remark that the shape of the new pattern shoe conduces to—
1. Solidity of attachment to the hoof, with fewer nails than were required for the old pattern; 2. Security of foothold; and, 3. Soundness of the foot. The first and third points are secured by the upper or foot surface of the shoe being flat, which gives it a wide solid bearing on the wall and margin of the strong unmutilated sole, leaving no space between for the lodgment of stones or mud, as was the case with the old pattern, and therefore obviating the necessity for a hoof-pick; and the second advantage is gained by the concave ground surface of the shoe, which gives a grip in soft soil, and diminishes the slippery surface on hard ground. These advantages are of great importance to Army as well as to other horses; and not less are those related to preserving the foot and limb in their integrity, and which are ensured by the new system of shoeing. Particular attention is paid to keeping the hoof in as strong and natural a condition as possible; so that the art of shoeing is reduced to its primary object—the protection of the hoof from undue wear, while it is simplified to the utmost.

Though the system has been only about three years in operation, nearly 500 men have been trained in "cold shoeing;" of course, many of these have taken their discharge, while a considerable number have gone into the Reserves, and it may be hoped that they will be available when required. At present there are 380 men in the ranks who are competent to shoe, and 166 are in training; at the same

time the regular shoers in the forges are up to the regulation number. In infantry battalions there are 206 trained men. These numbers will be added to every year.

The adoption of this system of shoeing has permitted us to introduce another most beneficial novelty. By simplifying the shoeing and allowing it to be carried on by these extra men, the sergeant farriers, and those who are in training for this grade, are enabled to attend a special course of instruction at the Aldershot Veterinary School, so as to qualify them to act as veterinary assistants. The urgent need that existed for men trained with this object has often been alluded to by General Officers in command of troops on active service; as the losses among animals have been greatly increased from the absence of skilled attendance on the sick and wounded, either on the line of march, in the field, or in the veterinary hospitals. Veterinary Officers are too few in number, generally, to give the sick and injured animals all the attention they require, and until lately the difficulty in obtaining men, even unskilled, to aid them has been almost insuperable. So late as 1882, during the Egyptian campaign, a Base Hospital was attempted to be formed, but the Principal Veterinary there reported that the Cavalry Officers "disliked parting with their men for hospital work, and each battery was of course unable to spare its only farrier. At last a farrier major of the 4th Dragoon Guards was obtained, but for some time he had scarcely any men to assist him."

It was not until the dispatch of troops to Suakin and Bechuanaland in 1885, that trained farriers could be furnished for this purpose. Up to that time Veterinary Officers had no proper assistance in their arduous duties in the field, and especially in the field hospitals. Beyond a chance farrier, who perhaps had no training at all, there were no men for the duty. Consequently, animals did not receive that care in having their wounds dressed, or their recovery from sickness or debility attended to; the losses and delays in recovery were therefore all the more considerable.

A number of the farriers specially instructed in the Aldershot Veterinary School accompanied the expeditions to Suakin and Bechuanaland, and the benefits derived from their services were strongly dwelt upon in the reports received at home. And the advantages in having such assistance will be even more marked in future expeditions, as the organization under which it is created has not yet had time to become perfected. It has been decided that all the sergeant farriers who possess a third class certificate of education shall attend this course of instruction at the Veterinary School; in addition to these, it is desirable that as many men as possible who possess the same educational certificate, and who have been passed as competent to shoe horses, should also attend the school for the same purpose, so as to fill up vacancies among the sergeant farriers during peace or in the field. With the view of meeting the demands of mounted infantry and regimental transport on active service, it has, as already mentioned, been decided to teach two men per battalion of infantry to shoe horses, and when so instructed the most intelligent of the two is to undergo the above course of special instruction. The

Royal Marines are to be included in this scheme. After attending the school these men, of course, return to their corps.

In anticipation of the adoption of the new farriery reorganization steps had already been taken in this direction. Indeed, since 1883 the system of training referred to has been in operation.

Up to the end of last year, 568 men had obtained the school certificate of competency, and the names and corps of these are entered in a register kept in my office, and in another in that of the Adjutant-General, any changes occurring being reported every month; so that we may know whether the men are with their corps, in the reserves, or non-effective.

By this means we shall be able to lay our hands at once, in case of war, upon a large number of well-trained intelligent men, to form what may be called a "Veterinary Hospital Staff," whose duties will be similar to those of the Army Medical Staff Corps; and, in addition, they can be utilized in the Remount Depôts, and assist in the supervision of animals on the lines of communication, in order to prevent those injuries and losses which are usually so heavy there. When not required for these duties, their special training will be most advantageous to their own particular corps.

All this will have been effected at an expense which is almost *nil*, and without any of the heavy cost and serious disadvantages of having a special corps of trained men.

Winter Shoeing.

The shoes worn by horses should not only protect their feet from external injury, but should also afford them security of foothold. I have shown that the new pattern shoe adopted in the Army does this in ordinary circumstances, by its concave ground surface, which also prevents stones, mud, and to some extent snow, from lodging in the sole. But for ice or slippery pavement—such as granite, wood, or asphalt in damp weather—something more is necessary to afford a secure grip.

Though our war operations generally take place in countries in which the winters do not require any special provision against ice-travelling, yet with our Crimean experiences still fresh in our memories, and the experiences of other nations to refer to, the necessity for being prepared for such an eventuality as a campaign in an ice-producing climate must not be lost sight of.

The Russian Campaign of 1812 furnishes an instance of the need there is for providing armies, not only with shoes to protect the hoofs from wear, but appliances which will make them independent of the winter in northern and western climates. The reference to this is to be found in Thiers' "History of the Consulate and the Empire" (Vol. XIV). He writes: "Napoleon left Dorobourg on the 6th of November. The whole of the Army followed on the 7th and 8th. The cold had become more perceptible, and once more gave rise to painful regrets at having forgotten to provide winter clothing; and another regret yet more baffling—that of procuring frost nails for the shoes of the horses. The season in which the Army had left, and the belief

that it would be able to return before the setting in of unfavourable weather, explains this double omission. Our unfortunate soldiers marched along, wrapped up in every kind of clothing saved from the flames at Moscow, without being able to guard themselves against a temperature of 9° or 10° (Réaumur); and at each ascending portion of the road, the artillery horses, even when the usual number required was doubled and trebled, were unable to drag the guns of the smallest calibre. Flogged until they were covered with blood, and their knees torn with frequent falling, they were found incapable of overcoming ordinary obstacles, through loss of strength and want of means to prevent their slipping on the ice. The ammunition wagons were abandoned, and scarcely any ammunition was saved. Soon after, the guns had to be surrendered as trophies to the Russians, but not without pain and shame to our brave artillery. The carriages were thus greatly diminished in number, and every day saw the losses augmented, and the horses expiring on the road."

Another marked example is to be found in *The Times* correspondent's account of the Danish retreat from Schleswig to Sonderburg, during the Prussian-Danish War, on the night of February 5th, 1865. Immediately after it had been determined that the Danes should effect a hurried retrograde movement, bad weather set in with great violence. "The snow thickened and hardened on the ground, the road became smooth and bright as glass; horses and men slipped dreadfully, and fell at almost every step. Not one horse in the whole Danish Army was rough-shod that night; on the contrary, the shoes both of saddle and draught horses were worn smooth by the five or six days' incessant march on muddy ground, and the progress of the Army met with terrible hindrance at the outset. . . . It was not long before our march began to exhibit, on a small scale, some of the horrors of the famous retreat of the French from Moscow. The night was dark—the cold terrible; the thermometer, I daresay, did not mark more than four or five degrees below the freezing point—but the chill in our veins told a very different tale, and the slipperiness of the road was perfectly awful. The snow, which was falling thick and fast at frequent intervals, lay in the fields three or four inches deep, and fringed the trees in the forest with the most picturesque fretwork; but it was trodden to the thinnest layer by all the feet, hoofs, and wheels of a whole host, till it glistened like ice in the occasional gleam of some pale star. . . . Dragoons, artillerymen, all who travel on saddle, were dismounted; even led horses were put to the direst exertions to keep their footing; draught horses had to be held up, and cannon, caissons, and ammunition or baggage wagons had to be dragged by the sheer strength of men, whose tread was no steadier. The falling of men and of beasts, and the cracking of wheels and axletrees was prodigious. It took us full nine hours to go over the first Danish mile and a-half (less than seven English miles) of ground. Morning broke upon us long before we were half-way between Schleswig and Fensburg, and we reached the latter place about four o'clock p.m. on Saturday, having accomplished the whole distance of twenty-two English miles in eighteen hours. . . . We had not gone half-a-mile from Schleswig, before we found

a very heavy piece of siege artillery forsaken on the road. The eight horses which dragged it had become, owing to the state of the roads, as powerless as so many new-littered kittens, and all the efforts of the men to share the work with them were unavailing. In the same manner as we advanced on our dismal march, we, who were in the rear, came up with broken carriages, dismounted caissons, and horses fallen never to rise. The obstruction to our progress was indescribable."

Fortunately for the Danes, the Prussian Army was no better provided than themselves with the means to enable their horses to travel on the ice; otherwise, the entire retreating force might have been captured, or at least severely harassed and despoiled. Profiting, however, by this experience, the Germans soon after had a system of winter shoeing introduced into their Army—that of steel pegs screwed into the shoes, and this proved of great value to them during the war with France in 1870–71, as the French were not so provided during the winter, and were, consequently, on many occasions placed at a serious disadvantage—at times, even, large forces were gravely imperilled. For while the Germans could move freely on ice-covered roads, the French mounted corps could scarcely stir. Numerous instances of this state of affairs were recorded at the time and subsequently, and one in particular was cited some time ago in a *Bulletin de la Réunion des Officiers*. "An officer to whom I was speaking of the necessity for having a good system of winter shoeing (*ferrure à glace*), told me that he had been of that opinion for a long time. He was with the Army of General Bourbaki during the war of 1870–71, and had witnessed the unheard-of efforts of the men and horses, to save as much as possible of their provisions and materials of war, on retreating into Switzerland. For lack of any better appliance, rags and wisps of straw were fastened on the horses' hoofs, while the men pushed the wheels; but their efforts were in vain! . . . This Officer saw a Lieutenant of Artillery in a state of extreme despair, because two of the guns of his battery had rolled into a ravine dragging their horses with them, owing to the unfortunate animals not being able to keep their footing on the snow and ice. . . In January, 1871, the retreat of Bourbaki's Army was converted into a veritable disaster in consequence of the absolute failure of shoes provided with appliances for ice travelling." The *Revue Vétérinaire* for October, 1876, corroborates these statements with regard to the misfortunes of the French Army of the East in 1870–71, due to this neglect. "Our Cavalry," says that Journal, "composed of good horses, partly obtained by requisition, was reduced to impotency by the obstacles which the snow and ice opposed to its progress; while the Cavalry of the German Army, furnished with steel screw-studs (*grappes d'acier à vis*) marched, as General Martinez, one of the unfortunate Bourbaki's Officers, informs us, with no more difficulty than if they were on the finest roads. This is a new instance," it adds, "for determining us to be provided for the future, and to discover the readiest and best frost-shoeing."

These examples will, perhaps, be sufficient to illustrate the

influence the art of shoeing has in maintaining the efficiency of armies, and what grave calamities may ensue, when, from lack of foresight, or through ignorance or carelessness, any of its details are neglected, and soldiers are helpless at a time of grave emergency.

What can be more discouraging to an army in retreat, than to be compelled to leave its feeble, sick, and wounded men, and its guns, ammunition, baggage, and stores, to be destroyed by the weather, or to fall into the hands of perhaps a merciless enemy; when some simple device, suitable to the occasion, would have saved them? The destruction of the horse and its rider, or the loss of a city for want of a horse-shoe nail, as mentioned in the proverb, is a mishap not so improbable after all.

There are various appliances for securing a foothold on ice or slippery ground, but the majority of them do not meet all the requirements that must be provided for. The ordinary method of "roughing," by taking off the shoes, heating them, and turning up a sharp calkin—in some cases welding on a sharp toe-piece, is most objectionable; because it damages the hoofs, requires much time, is very expensive, and only lasts for a day, when the operation has to be repeated. It was the only method we had in the Crimea, but it had to be given up as impracticable, and our mounted corps there in the severe winter of 1855-56 were, it may be said, immovable—utterly helpless. The screw-pegs which the Germans used in 1870-71 are an old invention; but they have their drawbacks in being expensive and require much preparation, while if they are screwed too far through the shoe they are likely to lame the horse, and they are also liable to break at the neck.

Frost-nails, if driven through the hoof, damage it, and if only fastened through the shoe, are apt to wound the horse's legs; while they are soon worn away.

Seeing the necessity there was for having some fixed system of winter shoeing in the Army, for more than a quarter of a century I have endeavoured to introduce a method which would meet every requirement, having tried all the others. About fifteen or eighteen years ago, when with the Royal Engineers at Chatham, I used steel pegs of a pyramidal shape fitting into square holes in the shoes. These answered admirably, and during the winter months the mounted corps employing them were quite independent of the weather and the farriers, as every man could render his horse secure against slipping in a few minutes. To ensure greater accuracy in the peg fitting into the shoe, in recent years I have had the shank and hole round, and this change appears to have made the system perfect. A peg is placed at the end of each branch of the shoe for riding horses, and for draught horses one or two in the toe. The pegs are of three sizes, are of tempered steel, and can be removed or inserted into the shoes speedily and with the greatest ease, by the soldiers themselves. By their employment a whole army could be rendered capable of moving at any speed over the most slippery surface in a few minutes, without the aid of farriers—for I maintain that no system of winter shoeing is perfect which requires the intervention of the farrier.

While in the 2nd Life Guards, I had the horses shod with the prepared shoes all the year round, blunt pegs being worn in summer to prevent slipping on the London streets, and sharp pegs if there was ice.

And this leads me to observe, that considering the very slippery character of the street pavements in our towns and cities, and the danger to horses travelling on them, and especially if troops have to act in suppressing riots, the desirability of having the shoes issued for everyday use all the year round prepared for these pegs, is a matter for consideration. At any rate, shoes for winter use should be so prepared; as at present, during frost and snow troop horses cannot leave their barracks, whereas they should be able to travel at all seasons of the year in any climate.

As I have stated, all the ordinary methods of winter or frost-shoeing are more or less objectionable, either because of the time required to effect it, the damage done to the horses' hoofs, the expense, the inefficiency, or the complexity of the means. What is above all needed, is a method which is at once so simple that it can be immediately applied by every trooper without recourse to farrier or forge; and so durable and effective, as well as safe and inexpensive, that it will cause but little inconvenience in using, or cost in providing.

This method appears to fulfil these demands. It is so inexpensive, that for a few pence a horse can travel securely at any pace on ice for a month, and it is so simple and readily applied that the horses of a whole army corps can be prepared for marching on the most slippery roads within half-an-hour.

It has been put to severe tests by myself for many years, and it has been tried repeatedly and successfully at home in Cavalry and Transport. One of these trials was in the 4th Hussars at Edinburgh and Glasgow three years ago, during a severe winter. The report was: "The cogs (pegs) are easily put in and taken out; very few have been lost, and none need be if they are carefully put in. They are also easily sharpened when worn down, and they last well." The horses so shod travelled on the ice and snow-covered roads nearly every day without accident, and with absolute safety—the men putting in the pegs on leaving the stables, and taking them out on returning to barracks, without the intervention of the farriers.

I may add that the Swiss Army has adopted our new system of shoeing, pattern of shoes, and appliance for enabling horses to travel on ice and slippery roads; and from a letter received from the Director of Artillery, Colonel Schumacher, the results were very marked during a recent trial. He writes:—

"On February 18th we assembled at Burgdorf, the 4th Regiment of Cavalry (3 squadrons) and two companies of guides. All the horses were shod anew, cold, with newly-ordered shoes from London (Greenwich); the holes for the pegs (Fleming's) were drilled in Thun, and the pegs were furnished from Vallorlies—all on the shortest notice. The farriers shod about nine or ten horses each per day, and on the 21st all went off for three days through the lower mountains, with ice and snow a yard deep everywhere. All went well, and even the wagons

were able to follow. Our new shoeing is a success, notwithstanding that all of Dr. Fleming's ideas were not adopted by all the members of the Shoeing Commission. The French were, I hear, very much surprised at the system working so well, especially the winter-shoeing."

It is a matter for regret that in towns which have slippery roads all the year, advantage cannot be taken of a simple plan like this to economize horses' powers, and spare them distress, fear, and injury. It is very painful to pass along some of our streets, and witness the amount of horse-torture and loss of power that occurs during certain states of weather; and it certainly does not say much for the common sense or humanity of those who shoe the horses or construct the roadways. It surely would not be undignified or degrading to adopt a hint from the Army, and guarantee the poor horses who have to toil on wood pavement and asphalte from cruel injury.

The Rev. THEOPHILUS BENNETT: I am sure if a horse could speak, he would thank the worthy lecturer for the very excellent paper he has delivered on the present occasion, and I would like to be voice for the horse, and thank him from the bottom of my heart for it. I have often wondered why a horse-shoe,—in Ireland especially,—is generally looked upon as an emblem of luck, and I never knew the reason until I heard it to-day. We find that for want of a nail the shoe was lost, for want of a shoe the rider was lost, and for want of the rider, I suppose, the city itself might be lost. Hence, I think, it is that a horse-shoe is the emblem of luck. Then, with regard to shoeing, I think the farrier requires to be a very intelligent man. We often see that the veterinary surgeon requires to be a cleverer man than the human surgeon, and why? The human surgeon can ask his patient what is the matter with him, but the veterinary surgeon has to find it out for himself. I think it is the same with the farrier. If I go to my shoemaker and the shoe pinches me, I can tell him, but with the poor horse if the shoe is badly put on, if it is not a good fit, he cannot tell him, and, therefore, I maintain that the farrier requires even more cleverness than the shoemaker. And, then, I often wonder how it is that horses seem to like to be shod so much. I often have the treat myself of taking a horse to the forge. I like to take him and see him shod, and I have often wondered at the alacrity with which he allows himself to be taken to the forge. I think it is that he rather likes it, and, therefore, I think those who are horse-owners ought to shoe their horses regularly and not to care for removing a shoe, paring the foot, and all that, and putting on the old shoe again. If we shoe them regularly once a month, their feet require very little attention, except on the occasion when the horse is shod. I have also found that when horses have a tender sole, it is often desirable to shoe them with leather. I quite approve of everything that has been said with regard to winter shoeing. I think it is a very good plan to have the horse shod in winter in such a way that you can remove the screw, and put in an ice chisel; then you have no trouble all through the winter. Your own groom can remove the little thing that is put in as a spike, and in its place put in the ice chisel, and that ice chisel I have found very effectual in winter in keeping the horse from slipping. I quite approve of what the lecturer said about the steel pegs. There is only one other subject I wish to allude to, and that is as to whether india-rubber might not be introduced advantageously in horse-shoeing.

Mr. LANCASTER: Mr. Chairman, ladies, and gentlemen, I did not expect to say anything when I came here, but after what the Professor has said, I think I am in a position to say a few words. I am not a farrier, but I am an amateur horse-shoer, that is, I have seven or eight horses of my own, and for years I have turned my attention to improvements in shoeing, and have spent considerable time and money in this way. In the first place, there is no doubt that these spikes are very good things, but I am surprised to hear the lecturer say that the blunt spikes will

prevent a horse from slipping, because I have made inquiries of those who had used them, and find that after the edge has worn off, they slip as badly, or worse than the common shoe, because there is not that surface exposed to the road. I have had considerable experience in trying various horse-shoes. You know that Douglas in his horse-shoeing work recommends shoes with channels. I have tried various channelled shoes. A gentleman spoke about india-rubber. I tried india-rubber. It is a very good thing on the asphalt, but it is not so good on a wood pavement, and on a piece of macadam the india-rubber is all gone in half-an-hour. I do not think that india-rubber, or any composition of india-rubber, would stand an hour on macadam pavement; therefore, if you want something to stand on all pavements you must find something else. I came to the conclusion at last that wood cut across the grain is the best anti-slipping substance that can be. Four or five years ago I took out a patent for this. I had an office and tried it for three years. I had it on my own nag horse, which I drove early in the morning through the streets of London. I have been on the wood pavement, on the asphalt, and on the macadam on frosty mornings when it has been very slippery and scarcely a horse could stand, and I have invariably come through the streets without slipping at all. I had gone for nearly twelve months without slipping, and I congratulated myself upon the good fortune I had. I can say that I have driven my horse for twelve months and that it has not slipped once. I was, however, on one occasion surprised and disappointed to find my horse did slip. But when I got home and had him examined I found that, unknown to me, one of my new shoes had come off, and they had one of the old-fashioned shoes put on, and that was the cause of the slipping. Some gentlemen wished to see it tried, and I took a very heavy wagon of manure—I am connected with land—up and down Ludgate Hill, and then they wished to see it further tried, and I went to Tooley Street, and there I suppose is the worst hill we have about London, from Tooley Street up to London Bridge. It happened to be a damp day, and the wood pavement was very slippery, but the horses went up the hill and over the bridge without any slipping at all, and the gentlemen were quite satisfied. I may be asked, why has not this plan been adopted? Well, unfortunately I had got into the hands of what I suppose you may call schemers, gentlemen who having got the cow to milk have kept on milking it for their own interest, and the end of it was that the solicitors of the gentlemen who found the money put a stop to it—the fault was not in the shoe, but with those who were going to bring it out. I am sorry I have not a shoe here; but since then I have still persevered, and I have a shoe which I am now trying, and have been trying for two or three months—the same shoe with this addition, that it is put on without nails, and after four or five different trials I have got the thing as nigh perfection as it can be. I will not say that it is all perfection, but in the course of a fortnight or three weeks I hope to be able to exhibit this shoe, and to show that it is a real anti-slipping shoe, and one that requires no nails to fasten it. Although I have been very fortunate of late years, still I remember that I had three horses that got pricked and died within twelve months, and there is no compensation for it. Farriers are very often poor men, and if you go to law with them, you get the worst of it, so that you have to put up with it. I think it will be a good thing if we can do without nailing a shoe on. With this shoe of mine a handy man would learn to put it on in a day, and I do not see why the time should not come when each horse soldier shall be able to put his own shoes on, and I am sure you will acknowledge that it would be a capital thing in war for every man to be able to shoe his own horse. I intend to exhibit the shoe in the course of a few weeks, and you will perhaps be able to see it then—at the Exhibition of Horse-shoes at the Animals Institute, Wilton Place, Kinnerton Street, Knightsbridge.

Major TODD, Middlesex Artillery Volunteers: I think from the humanitarian point of view alone that this question is well worthy of discussion in this hall. It has been commenced by an admirably written paper by Dr. Fleming to-day, which might well lead us all to ask ourselves why we cannot use shoes without nails. From the very commencement of keeping horses I always found that accidents were happening by pricking horses' feet, and I have no doubt whatever that that was the cause, either directly or indirectly, of a great deal of disease in their legs. I must say that my

experience has been rather different to that of our friend, whose horses always liked to go and be shod. I have found that a horse has objected to enter the forge because it had been so badly used by putting on the shoe and burning the hoof, in order to make the foot fit the shoe instead of the shoe fitting the foot. I have had to get rid of two horses at different times, solely from the fact that they objected to go into the forge, and fought and kicked terrifically when they were there rather than be shod. I was very glad to get shoes on them again and send them up to the hammer. I cannot help thinking that a shoe fixed with nails must be a great bane to the horses' health, and I know it is a great bane to the horses' owners to find that they had had horses pricked, and consequently they had to send them to the salt marshes or out to grass for some months in order that they might recover to some extent. Therefore to get a horse-shoe adjustable without nails I thought would be the *acme* of perfection. For twelve months I have used my horses shod with shoes without nails. I saw the nailless shoes exhibited at a show, and took the opportunity of discussing the matter fully with the man who was showing the patent from almost every point of view, in order to hear what he had to say about it. Of course when one sees a new invention of that sort, one is apt to think that it cannot be perfect, but I have no hesitation in saying that I have found in the twelve months that I have used those shoes that they are simply perfect, and have borne out every statement that has been made with regard to slipping, and with regard to having no particular india-rubber patent pad to fill up the space that has been cut from the frog, &c., by the blacksmith. Further, I was at the Agricultural Hall last year at the Military Tournament, and my horse's feet, shod with the nailless shoes, were examined by military Officers, and they were surprised to see how beautifully the frog had grown down and how sound the foot had become, and that when the horse travelled, whether on asphalt or on soft stuff, there was no place left for snow to ball in, no place left for a stone to get under. To cut away the frog seems to me most ridiculous, if not worse, for if you take up almost any hoof with a patent shoe upon it you will see that the horse's hoof has been made by the hand of man a very different thing from what it was by nature. You can see no frog in many cases, and in some cases the horses through having a frog continually cut away have got terribly injured and never recover, and very likely have to be poleaxed from that reason alone. If my horses were to die to-morrow and their feet taken off you would see the natural horse's feet, with the natural soles and frogs, with grooves round the outside edge for the shoe. The best natural shoe fixed with nails I ever used before I adopted this nailless shoe was a shoe brought out by a veterinary surgeon, who called it the Rational Horse-shoe, because he allowed the frog to grow completely on to the ground, and there you have the advantage of non-slipping, because when the frog is on the ground, the horse does not slip. I proved it every day last week with a horse and victoria upon asphalt and roads of all kinds, and, though I saw horses down in all directions, my young horse, only five years old, travelled with perfect impunity. That is the best proof that you can have. I have two draught horses shod in the same way, and I should be very sorry indeed to go back to the old system of nailed shoes. I can only express my hope that we shall shortly be able to get the shoes at a reasonable price, and made out of a good metal. It is not a question of what kind of shoe you shall have; it is whether you can adjust the horse-shoe to the foot without the horrible hammering of nails into the beautiful hoof.

Mr. F. DUCK (Army Veterinary Department): Mr. Chairman, Dr. Fleming, and gentlemen, I should like to add a few words in corroboration of what Dr. Fleming has said as to the system of cold shoeing. In South Africa in the Jaika and Galeka and Sekukuni War of 1878, we always had great difficulty in keeping horses useful and efficient for want of proper shoes and of farriers to put them on. The shoes and the nails of the old regulation pattern were too large for the small colonial horse, and we had to obtain shoes locally; those were of a very inferior quality. Then, as to the shoeing, the farrier gets in South Africa in private life perhaps 25s. a-day, and we never could persuade any of them to volunteer. The result was we were very much put to it to keep the horses going. For army horses it is always advisable to have them shod in the hind feet as well as in the fore feet. In the Sekukuni War we found this to be absolutely necessary. The colonial horses

never in their lives had shoes on their hind feet. Many of them at twelve or fourteen years of age would come back from a long patrol over hard ground, as tender as possible; the hind feet presented the appearance of having been rasped, almost ground away, and blood coming through in spots both at the frog and at the toe. In the Bechuanaland expedition in 1885 we took a supply of the new pattern cold shoes, and also a staff of trained farriers. For the colonial horses these shoes answered admirably; they could be worked either hot or cold. I have often seen a man alter the shoe on a wagon wheel and occasionally upon a stone, that is alter the shoe cold. Even the farriers could say nothing against them, and they are the most conservative of men. I remember asking a farrier, "What do you think of these shoes?" "He didn't think anything of them; they were bad." "Why?" "He did not know." "Did they work well?" "Yes, they worked well." "What fault do you find with them?" "Well, I don't know, except that they will hurt our trade, and therefore we are all dead against them." The trained farriers that were sent out were a most useful set of men, and in addition to the shoeing, they enabled the veterinary Officers to assume a very much larger charge; they gave them much more time to attend to the duties of the department, in fact, in the Orange River expedition we had always complete veterinary supervision. The casualties amongst horses, mules, and transport animals were very much less than they had been in any previous expedition in South Africa. In the Zulu and Boer Wars the losses were very great, I am afraid to quote them; but in Bechuanaland the percentage of loss was 6 per cent. horses and mules, and only 7 per cent. in the transport animals. Possibly for these small percentages, the veterinary staff may claim a little credit.

Mr. W. B. WALTERS, Army Veterinary Department: There are one or two points I should like to make a few remarks upon with reference to Dr. Fleming's lecture, and in support of what he has said with reference to the new system of shoeing, and the reorganization of the farrier's department. With regard to the new system of shoeing, Dr. Fleming has quoted from my report on the Suakin Campaign. That was the first campaign, I think, in which machine-made shoes were used. If I remember right, we had some little difficulty at first in procuring the shoes from the field stores, but afterwards, we had no trouble in keeping the horses properly shod. Had the campaign been extended, and the march across the desert to Berber taken place, it would have been impossible to have kept the horses properly shod up under the old system, because we could not have possibly dragged heavy forge wagons, coal, nails, iron, and all the plant necessary for horse-shoe making through the desert. Consequently, I consider, for active service, the new system is as simple and perfect as any that could possibly be devised. I have had some experience in the trials that were made before and after the Suakin Campaign, because during the time I was in charge of my department in Ireland, I was entrusted with the experiments that were carried on in Dublin. These experiments were conducted by two regiments, the 18th Hussars and the 16th Lancers. Both regiments were ordered to shoe "cold" for a given period, and no fires were allowed to be used. Notwithstanding this, I think I may say that horses were never shod more perfectly than those of the two regiments I speak of. On one occasion the General Officer Commanding, Prince Edward of Saxe-Weimar, intimated that he should like to see the working of the new system, and on a given day one horse per troop of the 16th Lancers was paraded in the barrack yard; these animals were shod by their own farriers. The old shoes were taken off, the feet prepared, new shoes altered to fit, nailed on, and the whole operation finished in a very short space of time, the longest time occupied being thirty-five minutes, and the shortest fifteen minutes, from beginning to finish. When it was necessary to alter the shoes for the purpose of fitting, this was easily done upon the wheel tire of a squadron cart. The horses were carefully inspected by the General Officer Commanding, and also the Officers of the regiment, and the result was most satisfactory. I think this is quite sufficient to demonstrate the excellence of the new system. With reference to the durability of the shoes, I found that they lasted—with ordinary wear—from thirty to sixty days, but they were not put to any severe trial, and the shoes were allowed to wear out completely. The regimental farriers were certainly not in favour of the new method

of shoeing at first, because the abolition of the contract system represented a pecuniary loss to them, but that, I am glad to say, has been successfully tided over, and the very men who were opposed to the system are now the first to recognize its advantages. As Mr. Duck has already observed, farriers are a very conservative race and naturally object to any new system, especially when it touches their pockets. That is now, however, a thing of the past as far as cavalry is concerned. The system is to be extended to the artillery and other mounted corps, and I very much fear we shall experience the same obstacles from the farriers as we met with in the cavalry, but I feel convinced that if the matter is taken up in a proper spirit all dissatisfaction will as speedily disappear. I remember well the shoes sent out to South Africa for use during the Zulu Campaign. They were hand-made and very inferior, so much so that very few could be applied without heating, and in many cases it was necessary to entirely re-make them. The trouble and inconvenience thus caused can readily be conceived. The great advantages of machine-made shoes are the ease and celerity with which they can be altered and fitted without heating, their uniformity of make, and also their durability, from the mode in which the iron is manipulated during manufacture. As regards the second point—if I may call it so—of the lecture, the reorganization of the farriery system is a most important movement. The experience of former campaigns has taught us that farriers are generally the first class of men to succumb to the hardships of war service, and that under the old system it was simply impossible to keep the horses properly shod up, or to provide skilled assistants in sufficient numbers for hospital duty. Under the new system we shall have a number of trained men in the ranks available for shoeing purposes, and a staff of farriers efficiently instructed in the details of hospital duties. We know that in war-time corps are frequently formed such as mounted infantry or auxiliary cavalry, and these corps require farriers, but formerly they could not be provided without depriving the mounted corps of the Army of men which they could ill spare. The present system provides for this difficulty. Another point of importance is that as an army advances, veterinary hospitals must be established along the lines of communication, and for this purpose we shall now be able to place our hands upon a number of trained hospital assistants in whom every confidence can be placed. This is a very important point to look at, because we know perfectly well that without men who thoroughly understand the care and management of sick and lame horses, it is impossible for a veterinary Officer who has miles of country to travel over every day, to do his duty satisfactorily either to himself or to his commanding Officers.

MR. QUERIPPEL (Army Veterinary Department): I feel sure you will all agree with me when I say that we have listened to a most interesting and instructive lecture from Dr. Fleming—interesting, because the question of shoeing must always be one of the greatest interest to everybody connected with the mounted branches of the Service; for what use would it be to have a good lot of horses, or if those horses were in good condition, if our system of shoeing were bad? Instructive I say, because the lecturer has brought very forcibly before us a new system—if I may call it new—a system of cold shoeing, which is now generally adopted in the cavalry. Five years ago, when in Dublin, serving under Mr. Walters, I had the opportunity of trying cold shoeing as an experiment in the Army Service Corps. The work of this corps in Dublin is hard, and moderately fast, and is over macadamized roads and pavements. What did we find? We found the shoes not only wore well, but were seldom lost. I think that then I was fully justified in predicting a grand future for cold shoeing. Years passed, and I had no opportunity of testing the system again, but when the opportunity did return it was on a very extensive scale. During the whole of the last drill season, while officiating as Inspecting Veterinary Surgeon of the Aldershot Division, I had six cavalry regiments, the shoeing of which I supervised. I could watch carefully the shoeing in all those regiments, and I can confidently say that no system could possibly have worked better. I could perhaps have spoken to-day from my own observations, but I had no certain data to go on. I could only have generalized, and therefore I thought it advisable to ask for some statistics with reference to the loss of shoes. Colonel Verelst, commanding the 11th Hussars, wrote to me that, including marching from various out-stations to Dublin, and from Bristol to Aldershot, going

through the whole set of manœuvres at Aldershot (and I must say that a drill season at that station includes fast work and hard work, often over rugged ground which would test any system of shoeing), he says, "No system of shoeing I have tried before has ever answered so well as this has done, and I am bound to say that from the 20th of June to the 9th of October, whilst we were doing such hard work, my regiment only lost forty-three shoes," that is, 10 per cent., reckoning one shoe to each horse. The 16th lost about thirty during the three months, and the 19th about the same, an average of four or five per troop. But there is one point with reference to the 19th I would like particularly to bring to notice, and that is that one troop during the whole drill season lost but three shoes. Now it is not because this certain troop had good feet (perhaps the feet were in good condition because the farrier was a good one), but if one troop could do that, why could not it be done generally through the Service? And I maintain that if the farriers and the assistants will only see that broken nails are replaced, and that the clenches are down before the troop starts away, very few, if any, shoes will be lost. I wish particularly to lay stress on this point, because Colonel Graves, in the discussion on a lecture delivered by Mr. Walters a fortnight ago, said that a very large number of shoes were lost by his regiment at Handoub, and if I gathered rightly, I think he attributed it to the fact that the clenches were rasped down for the purpose of making them look better. I think the cause must be looked for elsewhere, because I have never seen clenches rasped down in this way, and not only that, but if they are, it is against the Regulations. I think the cause must be looked for in the very peculiar ground over which the 20th had to travel. There is no doubt that they had to work over ground that tore the shoes off. There is one more point I would like to mention, and that is the issuing of shoes in time of war. To make this system a success, it is of paramount importance that all those who are connected with the issuing of shoes should be thoroughly acquainted with the number of sizes of shoes and the nails that should be issued with them. Now we all know the multifarious duties that devolve upon the Ordnance Store Department in time of war, and I ask, is it feasible to expect that everyone in that Department should have a knowledge of horse-shoes and nails? I say, No; therefore I would strongly recommend that an Officer of the Veterinary Department should be attached to the Ordnance Store Department, in order that he might be held responsible for the issuing of these stores. I know perfectly well how shorthanded we are in time of war, and perhaps an Officer could not be spared, but still there is always an Officer at the base to issue veterinary medicines, instruments, &c., and the issue of shoes and nails might also form a portion of his duties. It would obviate what occurred during the River Column of the Nile Expeditionary Force, 1884-85. I was in veterinary charge of this column, and attached to it was a squadron of the 19th Hussars. I at once set to work to make myself acquainted as to whether they were well supplied with shoes and nails, and you may judge how horrified I was to find that they had brought 6 shoes and 200 nails per troop, 12 shoes and 400 nails for a squadron, perhaps for three months' work. The shoeing, therefore, of that squadron was always a source of the greatest anxiety to me. There I saw those plucky little Syrian ponies, not more than 14 hands high, carrying heavy weights, galloping over solid rock without a shoe on their feet. Of course this want of shoes had to be accounted for, and the Veterinary Officer, in his final report on the splendid work done by the horses of this regiment, said that he had asked for 400 sets of No. 1 shoes to be issued, but that they were not forthcoming. At the last moment locally made shoes and nails were given, but they were so thoroughly bad, being too large and the nails also, that they were handed back to the Ordnance Store Department on the first possible occasion. I can only add one thing in conclusion, and that is, that I shall hail the day with delight when I see this system of cold shoeing generally adopted throughout the Service, for I am perfectly certain that those corps who do not adopt it in time of peace will fare very badly in time of war, for the great advantage of this system is that it assimilates the system in time of peace to that in time of war, and therefore makes everybody connected with shoeing acquainted with the duties that they will have to perform on active service.

Colonel COLVILLE: I should like to ask whether since the introduction of these

shoes more horses have been pricked, whether they have suffered in a greater percentage from quitters, because it is maintained by some that where you have fullard or bevelled shoes you cannot direct the nail with the same accuracy into the hoof, and that consequently there are more pricks. Has Dr. Fleming any experience on that point?

The CHAIRMAN (Sir B. Walker): I am sorry that I cannot see a cavalry soldier on his legs. One would almost have thought, after a lecture like this, we should have got somebody up to give us their experience. A more important lecture as regards that branch of the Service could hardly have been given. To-day, as I read over the lecture, I thought of the old story which was told, I believe with perfect truth, of 1848, when a timorous Minister rushed to the Duke of Wellington to tell him that 100,000 Chartists were going to march from Birmingham on London, and dictate terms to the Government. The only remark that the Duke allowed himself was a grunt, "Who is going to find them in shoes?" I think we may say the very same of our mounted services, cavalry and artillery, and I am very sorry that so few of those who might profit by the lecture have been here to-day to listen to it, and have left it to an old fossil like myself to say a few words on the subject. A great many years ago, when I was a Captain of cavalry, I was brought into communication with a gentleman named Miles, living in or near Exeter, who taught me instead of using seven or eight nails to use only five. I was very much impressed with what Mr. Miles said, and although I did not agree with all his theories, I adopted the system of shoeing with five nails. I had a very good farrier in my troop, and there was a particularly good farrier-major in the regiment. I hardly like to say what my memory suggests to me. I hunted for five consecutive winters in Ireland. I did not ride very light, and always rode pretty hard, and I only remember one occasion on which I lost a shoe. I took my horses out to the Crimea, where I still shod with five nails, and I perfectly remember during the short time I served with the cavalry there I only lost one shoe. Therefore, as far as my memory carries me, shoeing with five nails, shoeing with great care, which was necessary with the fewer number of nails, gave results which we certainly could not have previously looked for. I was in hopes Dr. Fleming would have told us something about nails, and I think he told me before we came into the room that at present they shoe with only four nails, and that the change is successful. I think that is a most valuable fact. There is no doubt that the late barbarous system of driving an immense number of nails into the horse's foot was most hurtful. And another barbarity of my early days with horse-masters was that the frog was always cut away in a *beautiful* manner. As well as I remember, I never allowed my farrier to use anything but a pair of scissors, he was never allowed to do more than trim off the rough edges. I do not know whether Dr. Fleming will support me in that. I think we have had a most instructive lecture. Most of the speaking has been, I might almost say unfortunately, from those who agree with Dr. Fleming, and I should have been certainly happier if we had had one or two speakers from those who do not altogether agree with him, because we should probably have drawn from him even more valuable observations than we have had in the lecture. I certainly do not differ with him. I entirely agree with him in all that he has said, and I must confess that I have seldom read, having much interest in this very subject, a more valuable and profitable lecture than the one we have just listened to. Dr. Fleming will answer some of the remarks that have been made, and he will then show and explain to those who take interest in the matter some of the instruments that are on the table. But I am confident that I am justified in asking you to empower me to tender to him a very sincere vote of thanks for the lecture he has given us.

Dr. FLEMING: The replies which I shall have to make to the remarks will be brief. The necessity for horses wearing leather soles has been mentioned. There is not a horse in the British Army shod with leather soles, simply because it does not require them. If the horse's foot is left in its natural condition un mutilated, it requires no artificial sole: and if the frog is left uncut and sound and strong, no protection for it is required. No doubt india-rubber will, to some extent, prevent slipping, as the horse's frog itself will; but it must be remembered that on asphalt and wood in certain conditions that substance will not do so. When there is a layer of greasy mud on such pavement, you must have something to bite

through it, or you will have slipping. A horse shod with india-rubber, if the pavement is slippery but clean, will not slip. Besides, india-rubber will not answer for draught horses. Horses which have to move heavy weights must have a firm grip of the ground. And I may remark that there are no horses in the three kingdoms worse shod, with regard to slipping, than those in the streets of London. If you go to Glasgow, Manchester, Newcastle, any one of our large cities, you will find their horses more reasonably shod, draught horses especially: these have projections on the ground-surface of the shoes in order to bite the ground. Nowhere out of London, perhaps, will you see horses labouring under the same painful conditions in moving loads that you will here. I therefore think the farriers of London, although they have a Farriers' Company of great antiquity, are greatly to blame for allowing horses to travel on slippery streets with shoes perfectly smooth on the ground surface: in fact, nothing could be better devised for facilitating slipping than the shoes the horses wear. For cavalry and for a horse which has to travel on slippery roads or ice, it is necessary to maintain safety of footing, and especially for those that have heavy weights on their backs or to draw, you must give the shoe rough sharp surface, such as we obtain by short projections from the shoes. We have found that out, and therefore our aim in the Army has been to give the shoe such a grip. We allow the horse to work with an ordinary shoe when there is no slipperiness, but provide every horse with means for enabling it to travel with safety when there is. The great object has been to introduce something which is at once simple, effective, and cheap. Anything which is complicated, like this shoe of Professor Domenick's, which is here before you, which has been used in the German Army, will not answer. This is a very cumbersome piece of mechanism: it will gather snow and retain it, and it requires a special shoe to fit it, while it is very heavy. I do not know that anything simpler has been yet devised than the system which is now introduced into our Army. Every soldier, on commencing a march in winter, can put a few pegs in his pocket, and he is secure against the weather. At Chatham, many years ago, the transport used to leave the garrison with ammunition for Gravesend, Maidstone, and Sheerness. The men had a few pegs with them, and were absolutely independent of the weather. We had some very severe winters then, but the men had no accidents. When the roads were slippery, they dismounted, cleared out the holes in the shoes, put in the pegs, and started on their journey. That is the kind of winter shoeing we want. Whenever you come to apply india-rubber shoes, or make a composite shoe of any kind, you have a great deal of trouble. In the first place, the farriers in London will not put on such shoes. Civilian farriers generally belong to Unions, and anything likely to interfere with their business they will oppose. Not only that, but when you come to put india-rubber, wood, or other material in the body of the shoe, the shoes will be very insecure on the horse's feet. The material, being soft, will not retain the nails. I have tried almost everything which has been invented, and have always had to fall back upon the old-fashioned nailed shoes. Shoes which are adjustable or fastened without nails have hitherto proved a failure. They have been tried for the last fifty years at different times; I have tried several myself, but they have all been very cumbersome, sometimes dangerous, and very expensive, or very apt to leave the horse. After all our experience, we come back to the old fastening with nails. I may remark that the man who invented horse-shoeing was one of the greatest benefactors the world has ever seen. He must also have been a bold man, because, to drive a nail into a horse's foot, without understanding the anatomy of that organ, must have been a very hazardous experiment. The immense value that shoeing has been to the human race entitles the inventor of horse-shoeing to a large amount of gratitude from us. With regard to horses being pricked in shoeing, such a thing is unknown in the British Army. The horses are allowed to retain their feet in a natural condition. So strong are the hoofs that we can teach an amateur quickly to shoe a horse in a few minutes and without accident. I think from year's end to year's end we do not have a case of injury in shoeing, judging from the reports which reach my office. But if the hoof is cut away and scarcely a y horn is left, then it requires a very skilled workman to shoe a horse, and there is great danger of the animal being pricked. Yet such a thing as a horse being pricked in shoeing should be one of the rarest events. I think there are 15,000

horses in the Army at home, and I do not think in any reports we shall find a single case of a horse pricked in shoeing. I am extremely sorry that some of the mounted corps Officers are not here to assist us in the discussion, because the opinion of those either for or against the new system would be valuable. It has had a great amount of opposition to overcome, but I am glad to say, so far as the cavalry is concerned, that opposition has entirely ceased. Cavalry Officers see the advantages of the system; and I think some of its very warmest advocates are to be found in the cavalry. I trust it will be found the same in the artillery and the other mounted corps. The supply of farriers in the field is a most important business, for in all the expeditions of which we have records, and those in which I have been myself, the farriers have been the first men to succumb to the fatigue of the campaign. Not only that, but by some bad luck in action they get knocked over in a most extraordinary manner. For instance, the 19th Hussars, in the action of El Teb, left two farriers on the field out of a very small number. Farriers are always coming to harm, therefore, unless we have an excess force beyond the actual requirements of the corps, we shall be in a bad fix. This number of extra men to be taught has been fixed at 10 per cent.; if these men go into the Reserve and others are constantly taught, in future campaigns we shall have no difficulty whatever in meeting all the demands for shoeing—we shall have a large number of men in the ranks able to shoe—the number, in fact, will be so large that it will be pretty well equivalent to every man being able to shoe his own horse. I do maintain that a man who rides, or who owns a horse, ought to know something about horse-shoeing. Every man who has to ride a horse day after day, and whose life may depend upon its efficiency, should know how to shoe the animal. I am a strong advocate for every Officer being able to shoe a horse. I will not venture to detain you longer, but return you my hearty thanks for your patience in listening to my lecture.

NAMES OF MEMBERS who joined the Institution between the 1st January
and the 31st March, 1890.

LIFE MEMBERS.

Christian, H. W., Lieut. K's Rl. Rif. Corps.	Flower, S. S., Lieut. 3rd Batt. Northd. Fus.
Salvesen, C. E., Lieut. R.E.	Norton, R. F., Lieut. 14th Middx. Rif. Vols.
Nicol, W. E., Major 7th Middx. Rif. Vo's.	Matthey, E., Major 1st Lon. Rif. Vol. Bde.
Skirrow, A. G. W., Lieut. S. Lan. Regt.	
Fanshawe, G. D., Major R.A.	

ANNUAL SUBSCRIBERS.

Gundry, H. B., Capt. R.A.	Hilliard, G. T., Maj.-Gen. late Mad. Staff Corps.
Harris, W. A., F.R.S.S.A., F.S.S., F.S.Sc. (London), late Capt. 8th Lan. Rif. Vols.	Elliot, W., Capt. R.A.
Williams, H. P., late 27th Regt.	Morris, W. A., Surgeon M.S.
Ray, Michael, Admiralty.	Kinnear, C. G. H., Col. 1st Middx. Arty. Vols.
White, H. S. Neville, Lieut. R.M.L.I.	Dalton, R. H., Lieut. Forfar. Light Horse Vols.
Lockhart-Ross, H. S., Capt. 3rd Batt. Gord. Highrs.	Maunsell, F. R., C.B., General R.E.
Parlby, G. C. H., Lt.-Col. R.A.	Kane, F. R. P., Capt. E. Surrey Regt.
Fenwick, G. C., Major Mad. Staff Corps.	Becher, E. F., Major R.A.
Knight, W. F., Major 2nd V.B. Royal Fus.	Harley, G. E., Major E. Kent Regt.
Simonds, R. H., Lieut. 14th Middx. Rif. Vols.	Beazeley, G. A., Lieut. R.E.
Malet, J. W., Capt. Northd. Fus.	Corbett, Sir John, K.C.B., Adm. (ret.).
Mitford, R. C. W. R., Maj.-Gen. late Ben. Staff. Corps.	Bogle, Archibald G., Rear-Adm. (ret.).
Curtis, P. F., Capt. 1st Wilts Rif. Vols.	Stirling, C., Lieut. R.A.
Burn, H. P., Capt. Rif. Bde.	Crum, A. S., Lieut. Oxf. Lt. Infy.
Grainger, C. E., Lieut. 3rd Kent Arty. Vols.	Marshall, G. H., Lt.-Col. R.A.
Emerson, J., Maj.-Gen. late Bengal Army.	Nicolls, E. G., Capt. R.A.
	Shipley, W. D., Maj.-Gen. late S. Lan. Regt.
	Martin, Eve'lyn C., Lt.-Col. (ret.).
	Lacy, Ernest E., Lieut. R.N.
	Hoskier, F. H., Lieut. 3rd Middx. Arty. Vols.

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OCCASIONAL PAPERS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications or books for review may be addressed to Colonel Lonsdale Hale, at the Royal United Service Institution, Whitehall Yard, London, S.W.

THE BRITISH SEA WAR-GAME.

By Vice-Admiral BATSCH.

(Translated, by permission, from the 4th Vol. of the "Deutsche-Revue," November and December, 1889, published at Breslau, by Trewendt.)

THE following excellent translation gives us the reflections of an eminent foreign naval Officer upon naval warfare in general, and our own Manœuvres for the last two years in particular. Vice-Admiral Batsch, when in active employment, had a reputation in his own country analogous to that enjoyed by Sir Geoffrey Hornby, as Commander-in-Chief of a fleet, and, therefore, any criticism by him has a special value. He clearly points out that attacks on seaports and territory are of little value when attained by simple evasion of a powerful naval force anxious to be attacked, and to settle the question as to supremacy at sea, upon which all naval warfare hinges. As this vital result cannot be decided by peace manœuvres, other operations are undertaken which give an air of unreality to the whole. It is curious so keen an observer as Admiral Batsch has not pointed out the fallacy of making the mouth of the Thames an objective. What, it may be asked, could a hostile squadron effect in such a position in the hourly fear of a British fleet heaving in sight? The worst could be a temporary interruption of the commerce making for the port. But somehow it has become an article of faith with many that such an arrival, attained by *evasion* of the hostile fleet, with the ability to remain for a certain number of hours—and the period is carefully watched—constitutes a dire event for this country. Such an appearance, after a series of defeats of our naval forces would, however, be most serious, and though the Thames might bristle with forts as high as London Bridge, they would have as little effect upon the situation as 200,000 Volunteers deployed along the banks.—S. EARDLEY-WILMOT.

"We are convinced that unless the French Navy thrives, the British Navy will droop."—JAMES' "Naval History," vol. v, p. 368.

It has often been asserted, and has never been denied, that the art of war is subject to change; yet this assertion is not so well justified in the eyes of the

professional as in those of the civilian. If we compare the war exercises of the present day on shore with those of the past, we find but little difference between them, except the changes in respect of firearms. The form in which the movements of an army present themselves to a non-professional spectator is still about the same. Man and beast remain as they were in former days; the arms alone are altered, and in peace-time the effect of this alteration is naturally not evident. For man and beast on land we must substitute man and ship on sea. Here also man remains the same as ever; not so the vessel upon which he plies his warlike craft. Had it likewise continued to be the same as before, the war exercises of a fleet would even now be confined to what was then sufficient. Dense clouds of smoke produced by coal and gunpowder wafted up from the blue sea with such striking effect would still be the principal components of the war pictures, and the zealous student of the art of war at sea would not have been a bit the wiser. The representation of maritime warfare has of late been taken up so actively that public opinion has been attracted to it much more than was formerly the case. The advances made in the matters of steam, electricity, and submarine mines play so great a part at sea, that the attention of the observer is permanently roused. Everyone is trying to make clear to himself again the significance of the naval question, and not a few suppose that with respect to this, at least, the art of war is not only subject to change, but that it is by degrees reaching its extreme point.

In comparison with former days warlike power has indeed been greatly increased; what with the assurance and certainty of movement given to us by steam, the possibility of rapidly covering great distances in any direction you like, of hurling ponderous projectiles with great penetrating power and large bursting charges with accuracy to a distance of two or three German miles, and lastly, the power of causing fatal damage to an enemy's ship by submarine explosions. These conditions doubtless necessitate a different application of the art of war, but no change in the art itself.

It is not surprising that we sometimes come to false conclusions, mistaking for the main point what were, and only can be, matters of secondary importance; for instance, in the case of a certain description of torpedo-boat, which was expected to play a part to which it is unequal; and so will it be with other things, which are judged of and treated in the same or a similar manner. The naval manoeuvres which take place annually have brought to the foreground in England all that concerns the fleet, to which the general political tension in Europe has not a little contributed. Many think that the advent of the next war is a mere question of time, but few realize what extension it must necessarily assume, and this is one of the substantial hindrances to its outbreak. It is assumed that particularly in England the extension of the suffrage has suppressed all warlike tendency. It is thought that the development of national power in a military sense is incompatible with such a high pitch of democracy, and one might admit this to be the case, if one were inclined to give weight to such views as the altered means of carrying on war have here and there called forth. As a matter of fact, the art of war has not as yet reached its extreme point; but the weapons of war have been sharpened, and the milder form of making war, which many believe in, must yet remain a thing of the future. In England there are plenty of peace-lovers, and of those who look upon the maintenance of a military force as in itself a crime and a survival of barbarous days; yet there is scarcely another country whose prosperity and high position has been so much; the work of war as that of our cousins beyond the Channel. W. J. B. Seeley, Professor of Modern History at the University of Cambridge, has lately demonstrated how an almost unbroken period of warfare commenced contemporaneously with the rise of real civilization in England, con

tinuing even until now. And because this is the case, the objects of maritime war and maritime war itself have gained in importance. This applies more to England than to other States, because its interests as well as its resources point to war at sea rather than on land. Attention has already been called to the great increase in its trade. The number of British ships which yearly enter and depart from British harbours is considerably above 600,000, that is to say from 1,800 to 1,900 daily; it has been remarked that on an average thirty-five ships are constantly to be seen in the Channel from Beachy Head, that a ship passes that point every five minutes, and that on an average 288 ships pass daily.¹ The value of the exports and imports and their economical importance take, without question, the first place; but the interests of the men employed in this traffic are also not to be underrated, for the amount required to defray the cost of labour, income, and salaries, is put at the considerable sum of 50 millions sterling a year; this is all the more worthy of consideration as the interruption to commerce consequent on war, apart from other mischief, would entail on one side the laying up of commercial vessels, and on the other the loss of income from freight; now the capital invested in British shipping is estimated at 100 millions sterling! According to Lord Brassey's figures the total number of vessels sailing under the British flag amounts to 37,500, representing a tonnage of 9½ millions. The total tonnage of France, Germany, Russia, and Italy, on the other hand, does not yet reach 4 millions, whilst that of England, Scotland, and Ireland alone exceeds 7 millions, the remaining 2½ under the British flag belonging to the colonies. In consequence of the maritime wars at the beginning of this century, the greatest part of the European freights were carried under the British flag, and even after the battle of Trafalgar, nearly 500 cruisers were required for the protection of this commerce; yet at that time Great Britain had not more than from 24,000 to 25,000 merchant ships, with a total tonnage of about 2½ millions. In these days England maintains, to guard her 37,000 vessels, not one-tenth of the number of cruisers, namely, 42; that is to say, one cruiser for every 100 steamers of 100 tons and upwards, while France has one cruiser for every 10 steamers over 100 tons. At the same time, maritime commerce has increased, especially for England, not only in the number of ships employed, but also in its value; hence the measures and means for its protection become of more importance. The fact has particularly to be noted that it is of more consequence to limit the duration of war on sea than on land; for in the latter case, goods can be brought into a country and exported from it without touching upon the theatre of war; whilst in the former case, this cannot be done, particularly where a country is, like Great Britain, completely surrounded by sea. In her case the unimpeded importation of food across the waters, not to mention that of raw material and other produce required for her manufactures, is a vital question, and it must be protected at all cost. This also is a condition which did not apply to England's last maritime war, and one which will make any future war much more trying to her. At the same time, we need not give way on that account to the extreme apprehensions which are associated with the idea of interruption to maritime commerce. If the power and nature of the means formerly available for naval war are compared with those which exist at present, even the non-professional observer must be struck by the remarkable contrast which we have already pointed out. What then happened can hardly take place now. In 1799 a squadron of some thirty line-of-battle ships with all the want of mobility inherent to that period was able to sail from Brest to Genoa and back without being observed by a single English

¹ Admiral Colomb, R. U. S. Institution, Feb., 1888.

squadron. In the present day such a performance would be in the highest degree improbable. Nowadays, too, we can hardly realize how only the half of an army intended for disembarkation should arrive at the appointed time and place, whilst the other half was delayed a whole month by contrary winds. Yet this was the case in Holland, also in 1799. Form whatever opinion we like as to the greater or smaller prospects of success for an expeditionary force by sea, it will not at any rate in these days fail owing to such mishaps as these. During the last Franco-German war a cruiser arriving at Madeira from Senegal received all at the same time the news of the occurrence at Ems, of the outbreak of war, of the defeats in the Vosges and before Metz, of the capitulation of Sedan, and of the capture of the Emperor. This could happen in 1870, and the ship in question came from a distant part of Africa; but in the present day there are few places of importance where such a thing could occur, whereas in 1798 there was nothing extraordinary in the fact that the French sent reinforcements from Ancona to Corfu a month after the island had fallen into the enemy's power.

The difficulties with which a blockading force had formerly to struggle hardly now exist. In those days the shutting up of all an enemy's ports, as carried out in the American Civil War, was never even tried. They contented themselves then with blockading certain harbours, and were glad if they could only keep under observation the enemy's forces lying therein or induce them to come out. It was much easier for blockaded ships to escape unobserved then than it is now. Such a thing may happen now, and, doubtless, it will always be possible, but it is a mistake to deduce from them that the introduction of steam has made a blockade henceforth impossible. The objects of such a blockade are two-fold: first, to watch the enemy's forces which are in the harbour, and, secondly, to put a stop to all communication with the outside for commercial or other purposes. Complete success has never been attained in either of these two objects, if by complete success is meant a thorough closing of the harbour. During the Napoleonic wars such a result was never even aimed at; in later days it has been attempted with the help of steam, but never with success. In treating of this point it is well to consider that the escape of the enemy's ships is, after all, a matter of secondary importance in its effect on the conduct of the war. First and foremost is the assumption that the forces opposed to one another wish to fight, and not to avoid each other; hence the blockade of a war-harbour has for its first object the observation and not the enclosure of the enemy's war-ships. The latter object applies to general traffic, and, as a rule, its attainment has not required the employment of war-ships of the first class. These are reserved for cases in which an encounter with the enemy's main force is expected. This principle has been always, and is still, the main point to be attended to in maritime war, the objects of which remain unaltered, although the way of attaining them is modified in accordance with the nature of the means most available. The defeat of the enemy's fleets comes first; until this is arrived at, all other aims appear only of secondary importance. Such, for instance, are the capture or destruction of the enemy's merchant ships, the shutting up of his means of supply (the so-called blockade), the infliction of damage to his coast by bombardment or otherwise, the occupation of islands and small colonies, the disembarkation of troops on smaller or larger scale.

Some, indeed, maintain that such proceedings are no longer legitimate; it seems to us, however, idle to have any doubts upon the subject, and it is better to be prepared for such attempts. The well-known "Declaration of Paris" is often interpreted as if intended to do away with all capture of enemy's goods at sea; but this is not the case, it is only directed against giving letters of marque to privateers. The conclusion of a Convention against

all captures at sea would be virtually an agreement not to trespass upon an enemy's territory—in other words, perpetual peace.

When Admiral Aube's theories upon "*La guerre de course*" became known, objection was made to them, not because they pointed to the capture of the enemy's goods at sea, but to the devastation of his sea coast; but no fair objections can be raised, even against forced contributions, as long as war itself is considered allowable.

The importance of captures at sea continues to increase, for the question whether certain goods are contraband of war becomes rather more than less complicated. Time plays a greater part in the conduct of war nowadays than it did formerly, and means of secondary importance for carrying on war take some time before they come into play. Such is the case with the supply of a great many things necessary for war. Even on land it has been proved that the supply of arms and ammunition in great quantities throws no great weight into the scale; this is still more true in maritime warfare, where, however, the supply of coals is invaluable. On this account the importance of a blockade gains strength, although steam gives greater facilities for breaking it. A number of adventurers enrich themselves by blockade-running, but the course of the war is not thereby affected.

The molestation of seaside places, notwithstanding the protestation against it before alluded to, will be more apprehended than ever, because they are almost entirely defenceless against modern artillery, and because ships can now encounter coast artillery with much less damage to themselves than of old. Yet, although seaside places have become much more open to attack, it does not at all follow that they should be more the object of attack than has hitherto been the case, for even their destruction will only act in a secondary manner upon the main result; it may, indeed, tell against the destroyer, for his efforts may weaken him without in the least affecting the enemy's main combatant strength. The same rule applies to the occupation of islands and colonies. The real possessor of all such territories distant and detached from the mother country is always the Power which commands the sea which bathes their shores. The command of the sea, however, is synonymous with the power of free movement for a force making head against an enemy. Much is said about this point, but the much is generally wanting in clearness. Thus it is the fashion to estimate the right to the possession of an island by its neighbourhood to the coasts of a powerful State without considering whether that State has the real command of the intervening waters. England held the island of Elba during the last years of the 18th century, but when the British fleet evacuated the Mediterranean in 1796, the first thing that was done was to withdraw the English troops from Elba. On the other hand, the possession of Malta by the French became, after the battle of the Nile, a mere question of time, although Vaubois did his best to hold it. The case was the same with Egypt. The French were able to hold their own against the Turks, and what the latter chose to call an army, even after they lost their sea communications, but they were obliged to give in to the English General. Loss of command of the sea is equivalent to a flank open to the sea, and when, in addition, the investment is complete on the land-side the strongest fortress on the sea-coast must fall. Such was the case with Genoa, in spite of Masséna's heroic defence, so also was it with Dantzic, and so would it have been with Colberg had not its sea-communications been kept open. One of the most brilliant examples of the kind is the defence of St. Jean d'Acre, which was also Napoleon's first really important defeat. Lastly, amongst the secondary objects of maritime war no small part is played by the disembarkation of troops, and by thus carrying the war into the enemy's country. Here, again, a school has arisen, according to whose tenets disembarkations are not so feasible as they were before the days of steamers

and railways. This is a mistake, and we shall do well to clear up the matter. One would suppose that the landing at Ismailia in 1882 would have opened the eyes of the adherents of this school; it is certainly remarkable that Arabi only became acquainted with the fact of this landing on the day of Tel-el-Kebir. It does not prove much, that the history of this century notices a number of unsuccessful disembarkations before the steam horse was at the disposal of the defender; for the mere possibility of an Anglo-Swedish attack from the sea was sufficient during the campaign of 1807 to make Napoleon place an army of 74,000 men on the German coast, and the comprehensive arrangements of the same nature which were made on the outbreak of war in 1870 are well known. The unfettered choice of time and place is a very strong element in favour of an expeditionary force and that which gives it importance. The introduction of steam has increased this importance, but this is not all, the great advance of the power of artillery also favours it. How much conditions have altered to the advantage of maritime expeditions may be seen by comparing the case of the last Egyptian expedition with that of the Anglo-Russian attack on Holland in 1799. The west wind which took the British fleet to the Texel kept back the Russians, who were coming from the east, for nearly a whole month, thus causing the failure of the expedition. The idea that the news of Masséna's victory at Zurich had its influence upon the results may be admitted, but there was reason enough for failure without it. How differently things pass nowadays! Two weeks after the departure of Lord Wolseley from England his fleet of transports had left a track of more than 3,000 sea knots behind it, and lay before Alexandria, whilst nobody imagined that the General would land a day later, not there, but at Ismailia. With regard to the practicability of a disembarkation, people are in the habit nowadays of examining a coast-line with a too critical eye, and are thus led to wrong conclusions, assuming that a fleet of transports will not venture to anchor on an open shore. The objection holds good, indeed, as to many coasts; for instance, those long, harbourless stretches bordering the Atlantic in France, Spain, and Portugal, which are mostly unapproachable; but this assertion must not be made general, for one need only remember that even the cumbrous Russian transport fleets, composed entirely of sailing-vessels, have repeatedly, and, moreover, during winter, succeeded in disembarking troops on the almost harbourless coast of Pomerania. Naval strategy is, without doubt, still a dark problem for many, but the existence of the science has been demonstrated in a very striking manner in a pamphlet by Captain Stenzel of the German Navy, which appeared not long ago, and in an anonymous article by a French naval Officer, which was published in the August number of the "*Revue des Deux Mondes*." The maritime Powers are reminded forcibly by the great revolution which has taken place in naval war material that this science must needs be reckoned with. The Russian, French, and English fleet manœuvres are the visible demonstration of the attempt to assimilate the conduct of fleets to the new ideas. The most interesting of these manœuvres are those carried out by the British squadrons; first, because their operations are the least concealed from public view; and, secondly, because the art of war at sea in the case of Great Britain stands before that on land. It cannot be denied that, as Captain Stenzel justly remarks, naval strategy has retrograded as a science since England has been supreme at sea. With the exception of the battle of Lissa no collision between naval forces of any importance has occurred since the Congress of Vienna, but that one solitary example of Lissa shows that strategical blunders can rarely be remedied by tactics, for it proved that the act of putting aims, which are at best only of secondary importance, before the main task in naval warfare, cannot go unpunished. The Italians weakened themselves in an aimless manner at Lesina, and thereby lost the game at Lissa.

Englishmen are very unwilling to occupy themselves with set and unsolved questions of a general nature ; when these crop up, they are treated as literary sport—read, and laid aside. Our neighbours prefer living from hand to mouth with regard to such matters. Should the time come when it appears positively necessary to solve an important problem, some belated panacea which has turned up on some or other previous occasion is revived, receives official approval, and is administered as a fundamental remedy for the ailment. This procedure is applied especially to the questions of military organization and to that of national defence. When, at the end of the fifties, Orsini's attempt led to political complications, the English remembered the dangerous vicinity of Cherbourg, a Commission was immediately assembled which reported that the harbours of England were almost defenceless, in consequence of which the *martello towers* of Sheerness, Portsmouth, and Plymouth were constructed at a cost of many millions, though, as people changed their minds, these works are not yet fully armed. It was very well known that the danger of Cherbourg lay not in her walls, but in her ships ; but it was thought right in the first instance to meet the danger with walls. Then they went to Kronstadt with a fleet such as the Baltic had never before seen, found that they could not force their way in front and could not get behind it, the channel not being passable for big ships, that, in short, the fleet could do nothing. So they built a flotilla as quickly as possible, which gathered the laurels, of which we all know, at Sveaborg, and afterwards died of gradual decline at Haslar. When, in more modern times, the Treaty of San Stefano seemed to threaten British interests, and at the same time some Russian cruisers appeared upon the ocean, it was thought advisable to take up the question of the coaling stations. They set to work, and were by no means remiss in the erection of redoubts and in the manufacture of guns ; only the most necessary part of the whole thing—the garrisons—are still deficient. The knowledge was wanting on all these occasions that one must know beforehand what to do in order to attain a definite aim ; the fact is, the nation had enjoyed an unquestioned supremacy for half a century, and no one felt bound to think of providing for the future.

Decisive maritime operations are generally carried out in a very simple manner. The struggle for victory which ensues upon the meeting of two hostile fleets is alone decisive ; the meeting itself occurs in a straightforward manner independent of artificial conditions, and if a fight does not ensue upon the meeting, there is no real war. It is probably this circumstance which has misled competent professional men like Bouet-Willameuz to assert that there is at sea no room for the real art of command, called strategy, and that the operations of actual combat constitute the whole science of maritime war. Two things were wanting to clear up this error : first, the warlike excitement which has been reigning during the last decade, and next, the complete revolution in the matériel of fleets. It is immaterial which of the two things exerted the greater influence ; but it is a fact that the more considerable naval manœuvres date from this time, and that they are now carried out annually. Germany and Austria set the example, but the British Admiralty deserves the credit of doing the thing on the largest scale and of expending the largest sums upon it. This is but natural, because a sea-frontier always presents itself before England whenever she takes a step to prove her strength. In order to form an opinion upon the value of these exercises we must needs cast a glance upon the nature and degree of defensive power required by England, and we must also take into consideration the constitution of her armed forces. At this moment the almost universally admitted insufficiency of her fleet occupies the front place ; in face of the fact that an Admiralty which only a year ago pronounced the state of

the Navy to be satisfactory has just been demanding twenty-one millions for its increase, such an admission cannot be contested, and yet when we consider the many and various tasks which this Navy has to fulfil, it is difficult to estimate its necessary strength in round numbers. If, however, we go to the root of the matter we must remark first of all upon the insufficiency of the Army. England has a Standing Army of, at the outside, 200,000 men, behind which a reserve of trained soldiers amounting, if we reckoned the so-called Militia Reserve, to about 100,000 men. The task of this Army consists in maintaining a picked force in India as reserve for the Anglo Indian Army, and in providing garrisons for the mother-country, of which latter Ireland takes up the larger part. If we allow 70,000 to India, 100,000 for home service, 30,000 remain for holding the smaller colonies, the coaling-stations, and Egypt. If we take into consideration the fact that most of the stations apart from the mother-country are strong fortresses like Halifax, Bermuda, Gibraltar, Malta, and Hong Kong, the insufficiency of the force available for their occupation is self-evident, for the less such places are capable of defending themselves by their own unassisted means the greater become the demands upon the British Navy for their protection. Its principal aims must be to paralyse or annihilate the enemy's fleets, and to secure all communications by sea.

The strength necessary for these purposes depends on the strength of hostile neighbours, and on that of the allies upon whom Great Britain can reckon. It is much more difficult to give positive figures for the requirements of a fleet than for those of an army, whose numbers are more easy to determine with exactitude.

It would be as great a mistake to make up for deficiencies in the army by strengthening the fleet *ad libitum*, as it would be to do the converse. We cannot say for certain how far a country may have to depend upon itself in both respects, but there is much reason to object to assigning the part of General to one of two allied Powers and that of Admiral to the other. The conduct of operations of war can never be thus so thoroughly split up into distinct portions as to release any one of the associates from shifting for himself at a critical moment. By the well-known Treaty of Westminster at the commencement of the Seven Years' War, the King of Prussia was to have the aid of eight English line-of-battle ships in the Baltic; all who have studied the course of that war know how much this help was required. Had Frederick received it, neither Kolberg nor the corps of the Prince of Holstein would have furnished so sad an accompaniment to the fatal day of Kuenorsdorf. As far as the elder Pitt was concerned, the will would not have been wanting to fulfil the compact, but he could not answer for his successor, and so the ships were not forthcoming, their absence being accounted for partly by more urgent claims for them elsewhere, partly by doubtful excuses. How far the required strength of a navy and of its component parts can be determined by experiment, how far the principles and usages of maritime war as formerly practised may be reconciled with the changes of material? Such was the problem laid before the English Admiralty for the solution of which a series of maritime exercises were carried out last year and continued in the present year.

In every picture on a large scale contrasts first attract the eye and occupy the attention of the spectator, even distracting it from the main point. Such was the case with the picture rich in effects which was displayed last year on the shores of Great Britain.

It was a war-game at sea, the principal interest of which was centred in a blockade, combined with predatory warfare and the imposition of forced contributions. A part of the ships enclosed in two blockaded harbours succeeded in getting out of port, this part was of sufficient force, as to

number, to relieve the squadron which remained blockaded in the other port, for united with the latter it would be stronger than the blockading fleet. One would suppose that the object of the two blockaded squadrons would have been to effect a junction, and then to fall upon a part of the enemy's force with a view of annihilating it. This, however, would not have agreed with the general idea given out by the Admiralty, according to which the blockaded squadrons were to break out if they could, avoid the blockading squadrons, and then commence a career of captures and impositions which, as it was assumed, would decide the overthrow of England. But if we here consider this matter in earnest and ask ourselves "Is this war?" we shall be inclined to reply in the negative. It is merely a well-designed attempt to make an impression upon timid people, upon the comfort of the "Landed Gentry," and the equilibrium of the "Stock Exchange." Calculations were made to an hour as to how soon after the exhaustion of the Liverpool granaries hunger would make itself felt, and the Bank of England would stop payment. There is room for difference of opinion as to the value of this object-lesson. Some, perhaps, went too far in asserting that the manœuvres degenerated into a game of hide and seek, but they certainly threw no light, as far as outsiders are concerned, upon the real meaning of maritime war. Its object is to interrupt traffic at sea, to close and debar communication with the coasts and ports of the enemy, and to gain the command, not only in a military but in a commercial sense, of all the seas which surround his shores. The thorough attainment of those ends is not arrived at by damage however extensive to the enemy's means of supply, by impositions and by capture of sea-freights, but only by destroying what serves to protect his communications and keep them open, namely, his main fighting force.

Last year's "general idea" neglected this object, which is to be regretted. It may be replied that this does not matter, as what was omitted last year may be added to the programme this year; but this is not so. Those who prepared the scheme converted a secondary into the primary object, and thus gave a false appearance to the war-picture. Incorrect assumptions are founded upon many important dispositions, and conclusions are drawn therefrom which are not accurate. The escape of the blockaded squadron is looked upon as a successful evasion of the blockader, and as scoring a point against him and in favour of the other side; but this would really only be the case if the evader succeeded in obtaining such additional strength as to enable him to destroy his enemy before the latter was reinforced. No such an attempt was however made, as it would have interfered with the Admiralty scheme; instead of this the squadron which escaped undertook work utterly unbecoming for the ships which composed it, for one does not require either ironclads or monster guns for exacting contributions, capturing merchant ships, and burning towns; nor is it good economy to bring such huge machines into play when any small vessels you like to use could do the work at much less cost. The Admiral who acted thus in war would be committing the same error as that of the Italian Admiral who attacked Lesina without taking any notice of the yet unbroken strength of his opponent; he wasted his own strength on matters of secondary importance, thereby weakening himself for the critical moment, and he suffered in consequence. We cannot, however, blame the English Admiral who went off with his squadron last year, because he was literally carrying out the idea which was imposed upon him, and which obliged him to treat an operation of minor importance as his chief objective. The *Convention* and the *Directory* laid down similar rules for their Admirals during the revolutionary wars, and in consequence their Navy gradually went to the bad. We must nourish confidence in victory; this is not, however, gained by burning and devastating the enemy's defenceless sea-places, but by measuring our own strength fairly

against his ; and this is not done by merely ordering our Admirals, as was often done on the French side in those wars, not to *avoid* battle.

It may, however, be argued that a fair representation of a sea-fight cannot be given, that it is not therefore practical to imitate operations which must lead to a conflict which cannot after all take place ; that fleet evolutions are, however, in themselves useful for the sake of the practice which they afford, and that it is better to make them lead up to some other object than to an actual combat. This leads naturally to a discussion of the value attaching to this game of war, and further to the conclusion that we have no reason to doubt its utility, but that this was obtained from the British manœuvres of last year at the cost of sound strategy.

It is contrary to all English precedents to open a maritime war by merely making turning movements so as to deceive the enemy. To assume that the order to "sink, burn, and destroy" applies only to private property cannot be admitted. This was, however, the very form and wording of the instructions which were given to British Admirals throughout the last century and during the first part of the present century, even down to the time of the Crimean War. When the French Admiral Bruix entered the Mediterranean with thirty ships of the line in 1799, he must have intended to annihilate his enemy, not to make all sorts of demonstrations and feints ; as far as the numerical strength of his fleet went, he could hold his own ; it is, however, doubtful whether his morale was equal to that of the English Admiral, who had just been gaining laurels at Aboukir, otherwise, although the general course of events would not have been in the least affected, there cannot be a doubt that the battles on the Trebia and at Novi would have been fought under very different auspices. Nelson, on the other hand, knew what he had to do, and what was to be expected, when on hearing of Bruix's appearance he at once disembarked the troops which he had just taken on board at Palermo for conveyance to Naples. One may suppose that the plan of campaign allotted to Admiral Bruix was about the same as that imposed upon Admiral Tryon last year by the Lords of the Admiralty, and as a trial of strength on the part of Baird was out of the question, all that remained for him to do was to go to London. Having got so far, we have nearly said all we have to say about last year's manœuvres. As surely as faulty strategy at the commencement of a war leads to bad results, so surely does an ill-considered introduction to peace manœuvres stamp them with an unreality which extends to all subsequent details. Admiral Baird really found himself in an "excellent position," the one and great defect of which, however, was that no one thought it worth while to attack him in it. If the enemy broke the blockade, he was to "pursue or take him ;" such were his instructions ; this, however, counted for nothing as long as the task of his adversary was simply one of "evasion." The blockaded Admiral was instructed by the Admiralty to defer for ten days the movements necessary to effect his purpose. But without this restriction the representation of maritime war in peace is already much affected by the fact that actual battle can only be very distantly imitated. The representation must be confined to movements, the importance of which depends upon time and place. In the case before us, this told all the more because the principal task assigned to one opponent was to get away from the other. The reality of the thing or the representation of the reality was anything but promoted by this delay of ten days, for the blockading Admiral was deceived by a proceeding which would have been, if possible, reversed in actual warfare.

The assumption is doubtless permissible that a squadron to which the task of breaking a blockade is allotted should not wait till this is complete, and until his opponent has so perfected all the means at his disposal, that it becomes doubly more difficult to break out. On this account the delay

imposed on Admiral Tryon was, to say the least, not practical ; on the contrary, we should not go too far in pronouncing it to be deceptive and unreasonable. The work of the Intelligence Department played a peculiar part in this representation of war. This work is, as we well know, divided into distinct branches, one of which deals with our own communications with the rear, the other with the enemy's movements. The British fleet which was attacking Ireland communicated in a sort of way with the bases on its own coast at Milford and Lamlash. Some fast cruisers were available for the purpose, and as there were not enough of these, the deficiency was made good by the employment of torpedo-boats, which were intended for a very different purpose. Intelligence of the enemy's movements was confined practically to what was gathered from some newspaper reporters as they came and went. Now it is quite unquestionable that such an introduction of private intercourse into peace-exercises is not allowable, assuming, as it is does in war-time, a form which cannot be imitated in peace. Spies are shot, if caught, whereas in peace-time the danger which attends the collection of information during war is non-existent. It was only in this illegitimate manner that the blockading Admiral was informed that his enemy intended to break the blockade—one of his reporters having been allowed to communicate with the shore at Berehaven. In the same way, a post-bag intended for the blockading Admiral came into the enemy's hands; the boat on which it was conveyed being captured by one of the ships which had escaped, and being smuggled into Lough Swilly under a flag of truce through the blockading squadron. We may leave the question undecided whether it is allowable to use a flag of truce during peace exercises ; in the case before us, its use was of the nature of a *ruse de guerre*, which was practicable in peace but unlikely to succeed in war, because no one would then allow such easy and unimpeded traffic with a flag of truce. We may think what we like of this part of the affair, but opinions cannot be divided as to the insufficiency of the communications of intelligence from the rear as far as the blockading squadron was concerned. The work of bringing ordinary news was confined partly to large cruisers, like the "Arethusa," partly to torpedo-boats, neither of which were fitted for the purpose, for by using large cruisers as despatch-boats, you expend fighting power on work of secondary importance ; whilst by employing torpedo-boats in this way you withdraw them from their own special vocation, getting thereby mail-packets upon which you cannot rely, because of their too great dependence upon wind and weather. No adequate preparation had been made last year for the use of the coast-telegraph stations for war purposes, and their assistance was not available for the blockading Admiral. The blockaded Admiral was better off in this respect : being superintendent of the *naval reserve*, there was a connection between him and all the coast stations, which very much facilitated the work of his intelligence department. We cannot conclude our notice of last year's naval manoeuvres without reference to another important point. Captain Stenzel, in his paper on "The Conduct of Naval Warfare," remarks very justly that it was a mistake on the part of Admiral Baird to weaken his squadron by detaching ships from it immediately after the escape of the enemy from Bantry Bay. But what else could he do, as no previously prepared arrangements for coal supply had been made ? That this be done in time of war is a matter of vital importance during its whole continuance ; it is only the expense which prevents this being done in peace-time, during which it is not convenient to employ all the resources of supply habitual in time of war. It is evident from the foregoing that in future maritime warfare coaling stations some few hundred knots in our rear will not suffice, and that squadrons which wish to be always ready for action must take a good part of their supply along with them. It is difficult work to ship coal at sea, and the attempt to do so has not as yet

been very successful, nevertheless it is one of the things which must be arrived at sooner or later.

English Admirals are at present of opinion that a corresponding number of ships must be maintained to relieve those despatched to take in coal; this means doubling the size of a fleet—the most costly way that can be found of settling the coal-supply question. In the paper which we have often quoted on the “Conduct of Naval Warfare,” fault is found with the blockading Admiral for having sent his small vessels to take shelter in the enemy’s ports. This will, however, have of necessity to be reckoned with in future warfare; it has even been done before now, and is sure to be an important feature in the wars to come.

It will be impossible to bar all such places to an enemy by fortifications, neither would it be wise to do so if you could. The question requires all the less consideration in the case before us, as in last year’s exercises the significance of fortified harbours and of coast defence was left out of court.

Clausewitz explains “strategy” to mean “the use of battle for obtaining military and political objects,” a most comprehensive interpretation. Battle is, however, excluded from peace-exercises, to which, therefore, a somewhat less comprehensive definition must be given. If, then, we understand by *tactics* the employment of our combatant power in battle, we should here define *strategy* to mean the “concentration of our fighting force at the right time and place.”

This strategical problem was neither set nor solved in last year’s British naval war-game. That of the present year may possibly give further instruction.

The conclusions derived from peace-exercises are often only of secondary advantage. There is much in their performance which is really like maritime war, but at the same time there is also much which only resembles it in appearance, and which leads easily to false inferences. The German language contains no fitting expression for an idea which frequently comes to the surface when treating of war, and it makes use in consequence of a foreign expression, we mean the idea of the “*imponderable*.” The first Napoleon was in the habit, when comparing the fighting strength of two Powers, to say that a single man of one State was worth such-and-such a number of the other. What caused the single man to weigh down the balance was this very “*imponderable*” factor, which Napoleon attributed partly to physical qualities, but in greater part to moral influences. Patriotism, good control of public spirit, the use of the intelligence for extensive and worthy aims, development and bracing of strength, both bodily and mental; all these things, as displayed in the habits and customs of a nation, compose that “*imponderable*” matter, the existence of which in plenty on the one side, the paucity or total absence of which on the other, create the inequality between them. The bad “*imponderables*” deserve mention by the side of the good, for they play almost as important a part in war as the latter—these are bad passions, fanaticism, covetousness, and selfishness.

When let loose and given play to recklessly they are often powerful agents, and their effect is seldom wanting. If we allow that the first Napoleon showed considerable mastery in the employment of both kinds of incentive to action, it may be pleaded in extenuation that, especially in the earlier wars, no one hesitated to take advantage of them, only not always with equal ability and good fortune. When these were wanting, the use of the bad incentives often turned against the operator. Naval war has always held the first place in Great Britain, and it is on the sea that the possession of those good “*imponderables*” has always been particularly advantageous to her. The power of enduring the hardships of a sailor’s life, the readiness to make those very hardships subservient to their warlike vocation, these are

specially Teutonic gifts ; the Anglo-Saxon has known how to make the best use of them, and the world knows the result. But also the hateful "imponderables" have played no small part in his success ; their effect in his work of war has been so unmistakable that it was near showing itself even in the peace operations. False imputations of horrible and dangerous deeds is, in the intercourse of nations with one another, a means of intimidation. It is used to inflame the passions, as when lately the story was invented that a war-ship of one nation had treacherously sunk that of another Power in a sequestered part of the Southern Ocean. Months must elapse before the utter falsehood of the report could be made known, and the effect of the lie on the thoughtless masses cannot be obliterated. If such or similar means are used in your own camp no apparent harm may come of it, but though no visible mischief may result the bad effect is always durable.

The curtailment of outlay on armies and fleets is always popular in England, and when a Government is not firmly in the saddle it is very reluctant to propose an increase of expenditure, and must be impelled to do so by an unmistakable display of public opinion. This is the only way of accounting for the introduction of predatory warfare into peace-manceuvres, and though the immediate inducement to do so disappeared since the last votes for the Navy were passed, it was thought proper to adhere to the system once it was started. Looked at from any other point of view, it is a course which cannot seriously be justified. We have begun by touching upon this point, to which we shall not have to return, because it makes an exception to the many useful lessons to be gathered from the last naval manœuvres. It will be sufficient to add that the relation which the captured vessels bear to the capturing ships will be very different in real war to what it appears to be in peace. By far the greater proportion of merchant-vessels will no longer find it necessary to play such a poor part in war-time as formerly, for the sailing ships will be all laid up soon after the outbreak of hostilities, while the steamers will make use of their freedom of movement, and will not fall so helplessly into the hands of the depredator, as was the case with sailing-vessels. Having thus disposed of the question of captures at sea, we will treat as lightly that of attacks on the shore-line, because the apparent result is hardly worthy of serious consideration. It may well be necessary to use strong measures to act upon British nerves ; in proof of this, if we had no other, we may mention the agony-pieces which are acted on British provincial stages ; one of the provincials could hardly believe that "Mary Stuart" was classed as a tragedy in Germany, where the really tragic effects were not produced on the stage. Where the circle of spectators contains a majority of people who hold such views it is of no use to try the game of *intimidation* upon them, though the mention in the newspapers of the large sums extorted as contributions fails not of its effect, but this must not be mistaken for practice in the work of war ; it is not even "*magnifique*," still less "*la guerre*."

We intend, in what we have just said, no reflection upon the Admirals in command as far as last year's work is concerned, for it was all in the programme, and was intended to be one of the principal features of the performance. Not so this year. As far as we know the representation and practice of predatory warfare was not actually enjoined, but it was carried out on a large and small scale by both parties ; the captured, except in one case, generally looked upon it as a good joke, and the ransoming of the seaside places alone led to any discussion ; the matter will cost a lot of ink-shed, and will not be settled before the next real war. Little has been said this year about the umpires attached to the fleets, perhaps because it was discovered that the tasks assigned to them were either too great or too small. Moreover, the sight of the most unprejudiced umpire is limited by the

bulwarks and the horizon of the ship on which he is placed, and of the squadron to which the ship belongs; his judgment is affected by relations from the influence of which it is hard to emancipate himself. Nowhere does the feeling of comradeship flourish more than on board ship; pleasure is a strong cement to unite those who share it, still stronger is the bond of common pain, of which even the greatest enthusiasts for life on the ocean wave cannot help admitting that the fury of the elements is productive. No wonder, then, if partiality, favour, and affection are occasionally produced; and unless it become possible to float a squad of impartial umpires in a balloon above the whole scene there will always be a risk of partiality being displayed. It is necessary to mention this also in our introductory remarks, because, like the "*imponderable*" before alluded to, it is a part of the arrangements which does not fulfil the expectations formed concerning it, and which has not the importance attached to it. The naval manœuvres of this year are very fruitful of instruction, on which account it was all the more necessary to preface our remarks upon them with what we have just been saying, because the proper comprehension of the lessons to be derived from them might easily be impaired by the circumstances alluded to. The experiment of a mobilization of the Navy, the nature of war at sea and on the coasts; such were the declared objects of this year's exercises, to be carried out, of course, only as far as compatible with a peace footing. An attempt at mobilization in time of peace, even of the land forces, encounters difficulties which make it of doubtful value. The completeness of the effective force, the war equipment, and the dislocation of the troops are only partially feasible, because the whole country is affected by these manœuvres, and on that account the leverage of urgent political reasons is required. A mobilization of the Navy is carried out entirely in the war-harbours, the increase of force which accompanies it consisting chiefly in vessels of all kinds which are at hand, the only thing omitted being a comprehensive completion of the personnel. Everything else is carried on just as it is when an increase to the effective land force is made in time of peace, as, for instance, what soldiers call the concentration of the Army (*Aufmarsch*), an operation which requires extraordinary and extensive preparations. But the completeness of the personnel in the case of the Navy does not encounter the same difficulties, for it is principally obtained from the maritime population; those who are drafted into the Navy still follow their own calling, and it is easy to limit the demand upon them so as not to damage private interests. The case is otherwise if we compare the mobilization of an army with that of a fleet in their relative significance. The above-mentioned urgent political reasons affect the actions of a fleet in quite another way. If the Oriental question crops up unexpectedly, we will say at Sofia, in the midst of the most perfect peace, almost without notice and without any declared object, the greatest activity is displayed, commencing almost simultaneously at Toulon, Spezzia, Pola, Stamboul, and Malta. No one asks why, or if one enquires he gets no answer, for none of those employed can at once give expression to the ideas which he has formed. If a similar restlessness displays itself also at Sevastopol and Nikolajeff the beat of the pulse will no doubt be felt in the British Channel; Cherbourg, Brest, Plymouth, and Portsmouth sharing in the excitement. Whoever watches the traffic which then passes between the Mediterranean and the British Channel will soon discern an increase of movement, and whoever reaches Malta shortly afterwards finds that the British Mediterranean Fleet has quietly been nearly doubled, and, if not quite to the same extent, an increase approaching to this will be noticeable in all the British naval ports, for Great Britain knows that it must depend upon its fleets, and on its fleets alone, come what will of Army organization, which is somewhat coming to the fore.

We may call these and similar ebullitions, together with the preparations arising from them, what we will, they have all the significance of mobilization, differing only from the latter in that the expression is not used. Whilst that word signifies the end of the preparations for war, the proceedings above described are only the first steps in the affair, and whilst, on shore, the prohibition to export horses is the first forerunner of a mobilization, so, at sea, an embargo on merchant-vessels is the immediate precursor to the same.

One must make this clear to oneself if one considers the naval manœuvres from the standpoint of a mobilization. We need only peruse the history of the present age to discover a whole series of mobilizations of this kind always accompanied by similar preparations for war, but which neither led immediately to war, nor prevented one, nor ended in producing one. At the same time, as is well known, this did not prevent great battles being fought without being in a state of war, or that action should take the form of impressive demonstrations; Navarino, Dulcigno, and Besika will serve for examples.

It was necessary to make particular allusion to this aspect of naval mobilization, because the exercises of which we are treating were calculated to give a representation of war with what was in the main a peace-establishment. The conditions to which we are here drawing attention deserve notice besides for another reason. In a navy like that of Great Britain, which has to provide for holding strong stations at a distance from home, the formation of new squadrons on passing from a peace to a war footing is but little required. The despatch of fresh armaments after the declaration of war is generally a tardy measure, the distances being usually so great that in spite of steam time has to be reckoned with. On land, in the case of each belligerent, it follows as a matter of course that the army must be concentrated on the frontier, the course of the operation being open to observers on both sides who can calculate it to a nicety. Such is not the case at sea. The concentration of naval forces must be completed, not only before the war actually begins, but even before the order to mobilize has gone forth, or else it comes too late. In the case of two armies opposed to one another, the passage of the frontier is virtually an act of war; but a Russian squadron may lie before the Bosphorus, and an English one at the same time before the Dardanelles, and yet it is not a state of war, for the waters are everywhere free to all comers, and it is even not considered a hostile act to infringe upon the zone of "flotsam and jetsam," which the stronger side will take the liberty of doing, whilst the weaker one will often put up with it, though he may sometimes protest against the act as contrary to international law, seldom, however, getting a hearing. The course which Great Britain has so often pursued is noteworthy with respect to this side of naval warfare. The electric telegraph was unknown at the time of her maritime wars, and in the instructions sent to foreign parts it was often necessary to anticipate events; hence sea captures were often in full swing before the actual declaration of war. This is one of the peculiarities of traffic on the sea, that hostilities may and do take place, as forerunners of war, because friends and enemies have been accustomed at all times to navigate the same waters, and because a meeting with the future enemy is more accentuated at sea than on shore. For instance, the embargo or the seizure of private property found in harbours under a hostile flag. It was necessary to refer to the foregoing as an instance of the very peculiar suppositions under which naval preparations for war are made. What is in that case required for a mobilization must not be confounded with what is wanted for a similar operation on shore, as we should otherwise be misled in our calculations, and should fail in attaining the object in view. The first objectives of an army concentrating for action are the points at which it will cross the frontier; those of a fleet are the

military harbours or other stations of the hostile squadrons. As to attain these points we need not set our feet on the enemy's territory, we may go there as early as we like. Our only restraint need be the question as to the amount of force at our disposal. The Power which wishes to protect its maritime communications must be strong enough to occupy this advanced position. It must be able to hold its own on the scene of decisive action, and must not be under the necessity of avoiding it or of seeking safety in "stratagems," and all manner of feints. Such being the case, all the things which with an army characterize the passage from a peace to a war footing, and which come into force at the moment of mobilization, must with the navy be in part carried out more or less long before.

In England the word *mobilization* has not the same significance as in countries where obligatory service is the rule. In the latter, when the order to "mobilize" is issued, all other considerations give way to its accomplishment. The State obtains complete disposal of the whole population fit to bear arms on land as well as on sea, and as the use of this power interferes greatly with the whole system of commercial life, it must needs be delayed until there can be no longer any doubt that the apprehension of war will be realized. This can well be done, because the peace organization which exists along with the general obligation to service provides for every post which has to be filled, and assures the required number of additional men. With regard to the personnel, the English Navy has its peace establishment, which mainly consists of the so-called "continuous service men" who enter quite young, and after twelve or twenty years' service are discharged with pensions, forming respectively the coastguard and pensioner reserve, and being liable for service in case of war. As these are real veterans their number is not great; if we reckon the peace establishment of the Navy at something under 50,000, we may put the coastguard at a maximum of 5,000, and the *pensioner reserve* at not more than 2,210. The figures show that these reserves do not count for much as a reinforcement, even when we add to them 2,000 "Royal Naval Volunteers," but they have the advantage of being available even before the outbreak of war. The "Royal Naval Reserve" is of much greater numerical importance. This force amounts to nearly 20,000, but it is only available to a very limited extent, for its members are in the employment of private shipmasters, and are scattered throughout the world. During the period of their engagement they receive a not very generous yearly allowance, having besides the obligation to serve in war-time if required, that of occasionally when at home going through a month's drill on board a training-ship. As the annual allowance is welcome as a supplement to their private earnings, making their total income up to more than a man-of-war's-man receives, they thereby receive a premium, as a naval Officer of high rank expressed it, to keep out of the Service, at any rate in time of peace. Moreover, as the infrequent and short periods of training for which these men are available are insufficient to ensure efficiency, the system does not receive general approval. Of the peace establishment which, as we have said, may be put in round numbers at 50,000, about three-fifths are on sea-going ships, two-fifths on harbour-ships, and these latter are the first available in case of any special armament in time of peace. As regards the matériel, there are at present always about 100 vessels of all sizes in commission, of which about 16 are heavy battle-ships, 50 large cruisers, and 40 smaller ones. The first reserve of ships consists of about half the number in commission, that is to say 8 battle-ships and the same proportion of smaller vessels.

In the second reserve are about 16 more battle-ships, 40 cruisers, large and small, and some quite small vessels. This last group is manifestly not to be reckoned upon in case of a sudden mobilization, but the same cannot be

said of the so-called *coast defence* ships, that is to say, 10 ironclads, 6 at home, 4 at foreign stations, and some 40 gunboats, mostly of an obsolete pattern. Now as the naval manœuvres take place in the home-waters, the above-mentioned 6 ironclads may be counted upon.

Of course, the ships in commission and in British waters, the so-called *Channel squadron* and the coast defence ships, making up altogether 18, mostly well-manned ironclads, are in first line for peace manœuvres. Seventy-three ships took part in those of this year, to make up which number it was necessary to put 44 additional ships in commission, to man and fit them out; of which 14 were at Chatham and Sheerness, 16 at Portsmouth, and 14 at Plymouth, so that in treating of the act of mobilization, in this instance, we have to deal with the ships and dockyards just cited. Bearing in mind that, as above mentioned, there are somewhat more than 100 ships permanently in commission, we find that the immediate increase to the active force was in the proportion of nearly 50 per cent., an increase which, as far as the personnel is concerned, would be no easy matter to supply, even in States where the general obligation to serve is the rule, because the reserves are not available in time of peace. In England, where there is no compulsory service, the same difficulty exists, for although a part of the reserve men are available, their number is insufficient, and this is especially the case with regard to the engine department.

It is certainly a great performance on the part of the "Intelligence Department" of the Admiralty, which was formed some years ago, that 44 ships should within four days be commissioned, manned, and fitted out. We should be mistaken, however, if we thought that this was done in a manner suitable to a state of war, and we must not take quite as a matter of fact the suddenness of the order to fit out issued to the dockyards. We have already noticed that the complements were to a great extent made up of coastguard and "pensioner reserve" men, we have only to add that the different training ships, gunnery ships, the so-called steam reserve-ships (receiving ships for stokers), and, lastly, in no small proportion, the corps of marine infantry, contributed their quotas towards manning the ships put in commission. The crews also of some ships which happened at this time to return from foreign stations were made use of. The engine-room personnel of the newly commissioned ships was only completed to within 25 per cent. of the establishment, and the deficiency was very severely felt during the trying manœuvres. In like manner there was a want of Officers, for Lieutenants alone were 200 under their establishment, in consequence of which Officers' duties were often performed by petty officers, which may answer passably in peace-time, but which in time of war would be objectionable, and not conducive to discipline. The four days allowed for fitting out were no doubt made the most of, though in some cases there may have been previous preparation. It would be going too far to say that after these four days the ships were really ready for sea and in fighting trim. The days are over when a Keppel could leave Portsmouth with untrained crews, and comfort himself with the assurance that he would not meet the enemy till somewhere about Plymouth, for in these days ships with their engines and armament are very different, and a real preparation for war requires more than was furnished in the case of mobilization now under notice.

On the other hand, the part played by the dockyards and their hands this year contrasted very favourably with the performance of the previous year; in this respect great progress was made. Whereas on the former occasion we hear of ammunition for breechloaders having been served out to ships armed only with muzzle-loaders, of torpedoes being issued which did not fit the tubes, of ships with a complement of 300 men being rationed for 600, such complaints were at least unheard of this year. The stores intended for each

ship with the inventory were kept separate in the dockyards, prepared and packed already for embarkation, but there is some reason to suppose that this would not have been quite the case had the demand been made at any other unexpected time. There was also no deficiency of means of transport in the dockyards. A systematic time table had been prepared for the four days' work; this was strictly adhered to, and experience showed that nothing had been forgotten, which was an excellent proof of the foresight displayed by the *Intelligence Department*.

Take it all in all, the way in which the whole thing was planned and carried out was very creditable, but it was not the practical representation of a plan capable of being executed at any time and place, and in a manner suitable to the conditions of actual war; hence it was not what we understand under the term *mobilization*. The same remark cannot be made of the representation of naval warfare which ensued. As in the case of the mobilization, unreality very much hampered the performance. Although the representation of a mobilization was not quite adequate, it would yet be unfair to say that a plan of mobilization is utterly wanting. This is not the place to discuss the question, suffice it to say that the plan not only exists, but that it is also thought out in a manner which does all honour to the foresight and to the practical judgment of our English cousins.

If unreality gave in some respects a false aspect to the manoeuvres, the lessons which were derived from them are unmistakable. The effect of steam-power upon strategy and tactics, of the electric telegraph upon the work of the *Intelligence Department*, was brought out in a very remarkable manner. One point which shines out clearly in this year's manoeuvres is the direction given to them by those in supreme authority. The Admiralty associated itself with the war this time, which it had not done before. Thus, in 1887, one theatre of war had been chosen in the Irish Channel and another in the British Channel, each independent of the other, so that neither the one nor the other had even any system of getting intelligence from the coast and using it for the common good. In 1888 the fault of entirely separate theatres of war was avoided, but the conduct of the war was confined to the Commanders at sea, the Admiralty itself remaining neutral and thus placing itself in a false position; for when war is being carried on near your own shores unity of command cannot be dispensed with. This fault was also entirely rectified in 1889, and it will be seen how excellently the change told upon strategy.

The English harbours served as stations for the fleet designated by the letter A, those of Ireland for that known as B fleet, the former under Admiral Tryon, the latter under Admiral Baird. As battle-ships, A had nine ironclads, B had twelve; A Fleet had also five squadrons detached to different English harbours, composed of smaller, partly protected ships, and designated by the letters C, D, E, F, and G. These were to serve as second line of defence, and, although confined to the neighbourhood of their respective stations, were otherwise free to act as required. Ten cruisers, for predatory warfare and for scouting duties, were attached to the English fleet, and fifteen ships and smaller vessels of the same description to that of Ireland. In naval warfare the chief strength lies in the battle fleet, which is not limited to local defence and which is capable of free movement. It occupies at sea the same position as the field army on land, and is intended to serve the same purposes as the latter. Each battle fleet is the main objective for that of the enemy, each trying to fall in with the other and to engage it so as to produce a general action, which will be followed by minor engagements. This search for the enemy on land requires a great deal of art on account of the difficulties of movement and supply, also of those created by the nature of the country and the different means of transport. This art is

displayed in the general idea and in the *critique* of the autumn manœuvres of an army. As the war-objective of a fleet is the same as that of an army, it may be thought that the general idea for its manœuvres should be similar, but this is not so, because there is no room at sea for the "art" of which we have spoken on account of the simplicity of movement, of the "terrain," and of arrangements. Indeed, we may go further and assert that not only is there no room for "art," but that the great simplicity peculiar to the movements of fleets leads, in our peaceful imitations, to undertaking tasks which produce much that is inconsistent with real war. For instance, the Admirals were empowered by the "general idea" to assume at pleasure, according to circumstances, either an offensive or defensive attitude, laying aside, however, when attacking, any idea of actual collision, and aiming at objects the attainment of which could only have a secondary effect on the general result.

The rules laid down for the game contributed to the same end. These are of such a nature as to exclude the formation of any opinion as to the respective tactical skill displayed by ships, and as to prevent the question of tactics arising at all between ship and torpedo-boat, for all ships were directed to keep at long distances from one another, and actual collision only took place with specially prepared torpedoes. The latter, though just as numerous as last year, came on this occasion but little into play, and we shall, therefore, have nothing further to say about them. That torpedo-boats were again often used as scouts and despatch-boats is a misuse which, as it seems, is not so easily dispensed with. As the representation of tactical defeat which leads in war to a crisis is not feasible, the "general idea" takes another direction, and what in actual warfare at sea would only follow upon a general engagement, being therefore of secondary importance (we mean the coast-attack), becomes the principal aim. Hence arises the fault that such attacks on the coast or rather on harbours are undertaken, although the enemy's main strength is still unbroken. In order to arrive at this end all means must be employed to avoid meeting the enemy's main force, and whereas in actual warfare all instructions are calculated to produce a meeting with it and to break it up, in sham war the whole thing turns upon the invention of stratagems and clever dodges, by means of which you manage to follow the rules of the game. According to these the undisturbed possession of a harbour for eight hours constitutes a victory. In order to prevent the enemy from gaining such a victory in the Thames, the English Admiral, in 1888, steamed thither with all his force after the Irish Fleet had slipped out from the harbour which he was blockading, and meanwhile the western ports were requisitioned behind his back. This time the Irish Admiral was not blockaded, and could go where he liked, and so planned an attack upon the Thames. As, when you have to avoid your enemy, speed becomes the principal thing, he kept back the slower ships of his fleet and despatched the faster ships in two divisions by different routes, so as to escape notice. Either by mere accident or by the remarkable ability of his opponent, the separate divisions fell in with superior forces of the enemy, and three ships had to strike their flags in obedience to the manœuvre rules, that is to say, nearly half the attacking squadron; the stratagem was discovered, and the plan had to be given up, a further result being that the Irish Fleet, which was originally about 25 per cent. weaker than that of England, became now less than its opponent by 43 per cent., and in consequence all idea of plans on a large scale had to be given up.

The fault inherent in the plan which failed has already been noticed; but its unfortunate execution teaches us that an Admiral should not divide his strength in the presence of the unbroken and united force of the enemy; that he should not leave that force out of consideration, and that attempts to

e'ude such an unbroken force are very objectionable. Thus the capture of the "Hero," "Camperdown," and "Immortalité" was the first great incident of this war-game, and for that reason of interest, because it gave the English Admiral Tryon the opportunity of a movement which hindered the junction of the enemy's divisions, and afforded a victory to Tracy, his second in command.

As now, after such a serious loss, the Irish Admiral was prevented from achieving anything great, there remained for him nothing but harbour attacks on a small scale. Admiral Baird's second in command, Admiral D'Arcy Irvine, moved with the two ironclads "Anson" and "Collingwood," afterwards joined by the "Inflexible," round the north of Scotland to the east coast, where he levied contributions on *Edinburgh*, *Aberdeen*, and *Peterhead*, a proceeding of very doubtful value for purposes of instruction, but this very raid led to an incident, the value of the lesson to be learnt from which, cannot be over-estimated.

When the writer of the article in the "Revue des Deux Mondes," on modern naval warfare, concludes with the expression, "There is then such a thing as naval strategy," he could not have found a better example in support of his views than the fate of Admiral D'Arcy Irvine. Following the eight hours' rule he only remained that time before each of the ports Peterhead and Aberdeen; his aim was apparently the Thames, and he must lose no time in getting there. He did not, in any case, wait for an answer from the town authorities to his requisitions. On Saturday, the 20th August, he lay with the "Anson" and "Collingwood" before Leith, his Commander-in-Chief, Baird, being then at Queenstown, whilst the Commander-in-Chief of the English fleet was cruising off the west coast near the Lizard. The latter ran into Falmouth that day and heard of the appearance of D'Arcy Irvine before Leith. He saw from this that the Thames was threatened, and sent Tracy with four ships immediately to the "Downs," where that Admiral arrived at 2 p.m. on Sunday. Believing D'Arcy Irvine to have with him only two battle-ships—"Anson" and "Collingwood"—whilst he could himself dispose of two battle-ships—"Rodney" and "Howe"—and of two heavy cruisers—"Undaunted" and "Narcissus"—he moved northwards to meet his adversary, and arrived early on Monday at Spurnhead, where he learnt that D'Arcy Irvine's squadron had been reinforced the previous day by the "Inflexible," gaining thereby a superiority over him. He therefore retired on Aldborough, south of Yarmouth, to receive the reinforcements which he knew to be on the way. He had not long to wait, for the "Ajax," "Invincible," and "Shannon" arrived before Deal at 6 p.m. on Tuesday, and "Ajax" joined Tracy at 9.30 the same evening. The Admiral, having received this accession of strength, moved off at once and reached Scarborough early on Wednesday morning. There he found himself in a thick fog, but he felt sure that the enemy was close in front of him, as D'Arcy Irvine's movements had been throughout reported to him from the look-out stations. Knowing that he might meet with the enemy at any moment, he kept all his ships ready to put on full steam at once when required; as luck would have it the fog lifted suddenly, and the weaker enemy being caught unprepared—that is, without sufficient steam in the boilers to get away—was obliged to surrender. Thus the Irish Admiral's Fleet is once more reduced by half its fighting strength.

In order to form an opinion we must now return to a consideration of the general situation. The Irish Admiral commenced the war with twelve battle-ships opposed to nine of his opponent's. He recognized the mouth of the Thames as the enemy's principal vulnerable point, and therefore chose it as his main point of attack. He sought to send thither by devious routes the ships which he looked upon as the flower of his fleet, trusting in their speed

to avoid the enemy, but in this he failed, losing two battle-ships, and thus reducing his strength to ten, and his numerical superiority to one. He, thereupon, sent out the remainder of the pith of his fleet on another expedition, on this occasion round the north of Scotland, with the view of reaching the mouth of the Thames by another track and of executing by the way a raid on the British coasts. He succeeded in the latter aim, but did not gain his principal object, for the defending Admiral was on the watch off the south-west coast, and, being informed of what was passing on the east coast, sent a superior force which came up with the Irish Admiral's attacking squadron in good time, and overpowered it, thanks to numerical superiority, forcing the Admiral's flagship to retire. As the "Collingwood" and "Inflexible" were then captured, the Irish Fleet was now reduced from ten to eight battle-ships, its original superiority being converted into inferiority. As is so often the case, one is tempted here, judging after the event, to credit the English Admiral with the greater ability. This would, however, be unfair, for in the first place we have to reflect that every move of the game can only be justified by the fact that it was make-believe warfare. Had it been a case of real war very little of what was done on either side would have been justifiable. Admiral Baird would really have deserved blame if in actual warfare he had, instead of using his superiority of twelve to nine to crush the enemy's main force, chosen a raid on the Thames as his principal object, but such an assumption is inadmissible. On the other hand, it is evident that an unmistakable and straightforward rush at one another, carried out by both parties in earnest, would have finished the war at once, which would have spoilt the game. There was a great outcry afterwards as to the proof given by these manœuvres of the value of superior speed. No one can be more convinced of the value of this quality than the present writer; still he is of opinion that the manœuvres now discussed gave no proof of it; or rather, we can only draw such an inference from these manœuvres, because we have to do with two adversaries, one of whom would never attack, whilst the other would never expose himself to attack. This may really happen, but it is not war. We have no right to question the ability of the most renowned of British Admirals because he twice failed in cutting off Bonaparte's transport fleet; on the other hand, Admiral Gantheaume has not usually been credited with special ability because he succeeded three times in avoiding the whole chain of English squadrons between the Channel and Malta, and in landing his division safely at Toulon. The division was saved, but the army of Egypt had to capitulate all the same.

The question of speed does not deserve the dubious treatment to which it is now often exposed. Whatever part the skilful handling of sails had to play in the old days towards producing British predominance at sea, the same part will continue to be played by the speed resulting from steam and mechanical power. Only we must not run away with the idea that speed is only meant to be used for catching and running away. The end of a war is near at hand when one side is only bent on catching, and the other on getting away; true war action consists in mutual endeavours to meet with a view to fighting, and in this way to bring things to a crisis. Speed is not only strategically useful, it has its tactical value, and furnishes, if nothing else, the only means by which a duel between ships with the use of the ram is made possible, supposing equal skill in other respects on both sides. Speed, again, alone gives the choice of the battle-ground and of the formation for battle; speed is power, and power is size; capacity is limited by size, and with it the weight of armament and everything connected therewith. Here, too, the question of economy is in no small degree involved, for the most expensive part in the construction of a ship is that which comprises the engines, but the proportion of this part to the total is reduced as the latter increases, even

when speed is at the same time augmented. The manœuvres do not furnish good grounds for tactical conclusions in consequence of the disturbing influence of the rules which were framed for the guidance of those concerned. Torpedo attacks, the only tactical attacks which were admissible, were not attempted on a scale worthy of notice, because hostile encounters between ships and squadrons only took place on the high seas. Where harbours were attacked no torpedo-boats were at hand for the defence. The main conclusions, then, are in the domain of strategy. In a few words they are these, that the main objectives of maritime warfare are subject to the same considerations as those of war in general, that the course of a war at sea has been much affected with respect to preparations, to the first movements, and to subsequent operations, by the changes which have been introduced with regard to mobility, armament, and means of defence, and, lastly, that the fault of trying to avoid an encounter with the unbroken force of your enemy in order to gain some secondary advantage, will never rest unpunished.

This is the principal moral of the English naval manœuvres of 1889. We have asserted over and over again that the manœuvres had on both occasions much more the stamp of peace than of war. They were not, in fact, calculated in every respect to give a true picture of the latter, but still it would be unjust to underrate their great merits. In a country where the most unlimited freedom of public discussion reigns, and where little opportunity is given for quiet and independent official action, these manœuvres serve as a healthy lesson. Numerous defects were brought to light and made public, which were not exactly calculated to flatter the national vanity, since they became welcome food for the hostile press, both at home and abroad, gaining thereby, especially in the eyes of the distant observer, an exaggerated importance, whilst whatever strong points came to light were but little noticed, because it required actual war to bring out their full value, and because, as we must in all justice admit, overweening self-admiration is not a British habit. Such manœuvres are undoubtedly a means of measuring the power of a nation, and furnish the opportunity of forming a judgment upon it. This is not unimportant at a time when all the Powers, especially those of Europe, feel the need of testing their muscles, and when everyone wishes to weigh well in the balance. The military value of the English alliance is now much discussed. The opinions of foreign diplomats and of soldiers upon this point are not in unison. The statesman sees and feels the working of the hidden, invisible might which at times comes out in strong contrast to outward appearances, making itself felt in Great Britain's favour. It is a might which seems to him to wax instead of to wane. The soldier, on the contrary, misses that military value which he estimates by the method, energy, and outward display of force to which he is accustomed in his own country. He misses the general liability to serve, the drill, the numerical strength, and looks on with a shake of the head when England shuffles up together the whole array of her armed strength and succeeds with trouble in despatching an army corps to take part in one of her little wars. The case is very different with a naval force; you cannot make pretence of a ship, but there may be many a sham battalion whose ranks remain from year to year unfilled. Every gap in the array of a ship is at once discernible and tells irresistibly upon the efficiency of the division, of the squadron and of the entire Navy. The average Englishman does not believe in building up warlike power in our sense of the word; the spasmodic exertions which the British War Ministry makes from time to time in this direction always give way before any reactionary movement, and it is only since the commencement of the second half of this century that we see any signs of systematic progress. "The fact is admitted," to quote a communication addressed to the "Times," "that we have no war organization; that our cavalry regiments,

infantry battalions, batteries, and other tactical units have grown up without any method, one after another according to the inspiration of the moment, that every war in its turn has produced its crop of augmentations of some kind or another, which are, at the end of the war, either retained or reduced, according to the whim of the moment. There is no idea of any general unity of organization, and what is wanting in the case of the tactical bodies is still more deficient in that of matériel; not to mention transport, ammunition, guns, tools, and other supplies of all kinds are stored away higgledy-piggledy without any heed to readiness for use in the field; excess in some respects, scarcity in others. The supplies thus collected are occasionally disposed of, but, worst of all, there is throughout inexcusable extravagance in the safe keeping and maintenance of obsolete and unserviceable stuff. In short, we have men and supplies, but the idea of making methodical use of them is utterly wanting. It seems incredible that thirty-two years should have elapsed since the Crimean War which might, one would suppose, have enlightened public opinion, before one came to see that an army consists of something more than a mere medley of battalions, squadrons, and batteries, and that such a state of things can only be compared with that of a house for whose roof slates had been furnished and for whose windows glass was in readiness, but for which the builder has no plan, and all other requisites are wanting. At the approach of any danger the War Minister of the day appears to see no other course before him but that taken by his predecessors of applying to Parliament for the means of augmenting the Army by 20,000 or 30,000 men and of buying a million's worth of fresh supplies and war material."

It is not possible to reform such a state of things in the twinkling of an eye, but our neighbours are well on the path of progress, at the same time we must never expect that their military system can or will be after the pattern of the Continental Powers.

The value of the English alliance, in a military sense, rests on other grounds. A doubled army will not make up for half a fleet any more than a doubled fleet will fill up the gaps, and make up for the deficiencies of an army.

Neither army nor navy can once for all be said to be the *first line of defence*, for the work to be done in front depends in each individual case upon the political and strategical situation of the moment; the point of real importance is whether the sources of national power favour its manifestations most by land or by sea. The answer for Great Britain is "by sea." Viewed in this manner the Navy comes first, and more especially bespeaks the sympathies of the nation. It is thought, or, at least, many think, that England, being an island, can only carry on war at sea. This is an error, war carried on exclusively on land is only one-sided, and cannot be entirely decisive for any country with a sea-coast. There are undoubtedly statesmen in England who think that the nation is free from complications on the Continent, but whenever they have proceeded to act upon such a theory, they have learnt by experience that it is not tenable, and the conviction that they must be prepared to throw at least two army corps into the scale is gradually making way.

For employing these in Europe, England's sea communications come strategically to the front. In whatever manner the Powers may be grouped, the influence of England upon the Baltic, the Mediterranean, and the Euxine will make itself felt. To assist in guarding the northern shores of Central Europe, to protect the southern flank of the Iberian Peninsula, of Italy and of the Balkan States, and to occupy the bases of the Bosphorus and Dardanelles in the East, are tasks which will give plenty of occupation to the British trident, and if, as Colonel Maurice assumes, the co-operation of an English squadron from Malta will so far free Southern Italy from moles-

tation as to enable that kingdom to place 300,000 men in the field, we see at once the connection of England with the league of peace, and Great Britain's power of carrying out the principle of "do ut des" is so great in political eventualities at the *New Hebrides* no less than at *Cairo* and on the *Heri Rud*, as to furnish a very promising contradiction to the at all events somewhat depressing idea of "fighting alone" entertained by some British statesmen. *Self-confidence* is a fine thing, but let it not degenerate into a "fool's paradise." Our expectation that the English military system will be purged of the defects which, to quote the words of one of their own essayists, still give it the character of a "masquerade," bids fair to be accomplished. The thought of being *able* to stand against the world in arms is elevating. If we have only to deal with mere local boundaries and interests, we may believe in it. It is easier, as remarks very justly a writer in the April number of the "Edinburgh Review," to appreciate the greatness of Russia, with its territory spreading in one sheet from *Poland* to *Kamtskatka*, or of the United States of America, whose shores are bathed by the Atlantic and Pacific Oceans, than that of the British Empire, whose possessions are scattered disjointedly over the globe; it is difficult, too, to estimate its defensive requirements. Public opinion on the Continent is apt to form a low estimate of the possible exercise of British power; more than half-a-century has, however, passed since the Russian poet, Khomiatoft, prophesied a speedy end to the "threatening monarch of the seas," instead of which we only perceive growth, prosperity, and a dogged steadfast adherence to principles which, if occasionally egotistical, yet work well in the long run. These are the very "imponderables" of which we spoke, which impart durability to the equilibrium of this great commonalty. As the Frenchman Langat says, "Un certain héroïsme froid, une énergie intérieure et toujours tendue, une force qui se contient, une vertu qui dédaigne les apparences et garde quelque chose de farouche;" and not unjustified is the description which Robertson gives of his native country in the following words, "She puts on her shawl very badly, and she is awkward enough in a concert-room, scarcely knowing a nightingale from a jackdaw; but—blessings long and large upon her—she knows how to teach her sons to sink like men amongst sharks and billows, without parade, without display, as if duty were the most natural thing in the world, and she never mistakes long an actor for a hero or a hero for an actor."¹

LUMLEY GRAHAM.

¹ "Colburn's United Service Magazine," August, 1889.

THE PRESENT STATE OF TACTICAL SCIENCE AND BATTLE TRAINING.

Lecture delivered before the Military Society at Berlin, on 11th December, 1889, by Major KEIM, Battalion Commander, Infantry Regiment No. 136.

Translated, by permission, from the German, by Major W. H. SAWYER, N. Staff. Regiment, Brigade Major, 1st Brigade, Aldershot.

1. *Science of War*.—The student of the science of war finds himself, in these days, more favourably situated than the tactician. The principles of this science, so far as they can be laid down, have experienced but little change during the course of the last decades. Intellectual superiority and great moral qualities, still continue, as heretofore, to constitute the principal conditions of success.

2. *Tactical Science*.—The situation is different as regards tactics and tacticians, and therefore with the great majority of soldiers, who are seekers after tactical knowledge.

The frequent want of agreement amongst writers, teachers, and speakers on tactical science, and the discrepancies between the Regulations prescribing the method of fighting, and the precepts of tactical science, are hindrances to them.

3. *The Regulations*.—The last of these difficulties could easily be got over by maintaining that the *Regulations* alone are binding, and that they include tactical science. The German Army, in particular, possessing in its "Field Service Regulations," and in Part II¹ of the "Infantry Drill Regulations," such excellent tactical directions, might, perhaps, be justified in holding this opinion. The real interest of the army would, however, be badly served were this view to prevail.

4. *Difference between Regulations and Tactical Science*.—The *Regulations* differ from *tactical science* in one essential point. The *Regulations*, are law—authority—and no doubt can be permitted to exist on that score. They therefore necessarily bear a more or less *permanent* character, and cannot be *kept up to date* sufficiently, to satisfy the ever varying and increasing requirements of the modern combat. This would not be practicable, nor could it be fairly expected.

5. Here it is that *tactical science* comes in. It should be entirely independent, must have no fixed dogmas of faith, and must not point to any other authority but that of truth and reality. Tactical science is in no way bound, as are the *Regulations*, to adhere only to that which coincides with prevailing views and formations. It must take into account the current and future changes, the new developments and creations of theory and practice. Its task is consequently serious and important.

6. *Science of War and Tactical Science compared*.—In the solution of this problem, however, the science of war enjoys an advantage over tactical science. The former possesses, and perhaps fortunately so, no real text-books. Its

¹ Translation published by Edward Stanford, 26 and 27, Cockspur Street, Charing Cross, S.W.

precepts are few and simple, and do not admit of being reduced to hard and fast rules, although this has been attempted.

Any amplification of Clausewitz's scientific definition and systematic formulating of the principles of war would not be advantageous. In order to secure reliable data for the study of the science of war, it is now more than ever necessary thoroughly to search *military history*, or, in other words, to devote special attention to that which will always remain of primary importance to the soldier, namely, the realities of life, and practice as opposed to theory. *Tactical science and tactics*, on the other hand, although they deal directly with the troops, and should therefore aim solely at that which is in accordance with war practice, are often to a striking extent more crude, pedantic, and reticent, in this respect, than strategy. Military history only too frequently experiences neglect at their hands. Its lessons, have sometimes even been treated with actual contempt, especially when they did not happen to fit in with any particular system of tactics.

7. *Influence of Formations and Drill-ground on Tactical Science and Battle Training.*—An honest and conscientious examination of these circumstances, will lead to the conviction that the *drill-ground* was only too frequently the principal obstacle to forming a *sound* conception of the fight and its mechanism, based on the *realities of warfare*. Though indicated in our "Infantry Drill Regulations," it will be long before this source of danger is unanimously and frankly acknowledged.

Man is possessed of a certain moral inertia, which causes him to cling to anything that is handed down from the past. Enlightened princes and eminent soldiers, have therefore always considered it an important part of their duty, to clear the way for the introduction of new and useful ideas and methods, regardless of the croaking of those who look for results *only* from what is either old, or well known, or has been tested by practical experience. Notwithstanding the fact, that the work of the drill-ground no longer corresponds with battle training to the extent it did formerly, it is found by some much more convenient to identify the drill-ground with the battle-field, as the scope for imagination is thereby considerably curtailed. But this has a common origin with the error, which overlooks the fact that *formations* never could or should be more than mere *means to an end*—never the sole object of training. In dealing with this subject, fighting formations should be considered in conjunction with the drill-ground. The danger of tactical *science*, and worse still, of battle training, being prejudicially affected by either, would then be diminished.

The Regulations of all the larger armies, have striven within the last ten years to render the peace training more practical, by the substitution of formations which are in accordance with war practice, for such as are merely suitable for drill purposes.

Tactical science, however, having failed, as yet, to arrive at any preliminary conclusions, and being even still at work, here and there, with formulae, promising but little results in future wars, it cannot be fairly maintained that practice is in advance of theory.

8. *Conservative Tendency of Tactical Science.*—Tactical science has only too often followed, with reluctance, the paths pointed out, or rather forced upon it, by the enormous progress made in technical matters and by improved armament with its altered methods of fighting. Just as linear tactics, in their day, clung with regrettable tenacity to their obsolete principles and formations, until compelled by the bloody lessons of the battle-field to give them up, we have lived to witness what a comparatively long time was required in most countries to readjust formations and training, to suit the altered conditions of fighting. The Prussian company column, still in use in these days of small-bore repeaters, has taken over sixty years to force its way into

the Regulations of most armies. It must, on the other hand, be admitted that formations have repeatedly been retained in the Prussian Army, which had long ceased to be suitable for war purposes.

9. *Tradition.*—A common explanation of the obstructive attitude assumed by many tacticians towards the altered requirements of warfare, was that they appealed to *tradition* and sought to deny that improved armament necessitated a change in tactics and battle training.

Tradition is, undoubtedly, of the highest importance, and worthy of careful cultivation in all that concerns the historical records of armies and their component parts, the proper pride of arms, and the handing down of glory and honour to posterity. But in all technical and tactical matters, tradition cannot be fairly appealed to, otherwise we should never have got rid of the spear and brute force.

10. *Tactical Science should anticipate War Experience.*—Tactical science should be based on experience and the practice of war. It should not, however, wait until the new technical and tactical elements have asserted themselves with mathematical precision in the next war, in order accurately to formulate its principles and their application. In these days, when events follow each other so rapidly, even in the military world, such delay would not lead to a correct appreciation of the lessons of tactical science, by which alone superior fighting efficiency could be secured.

When the needle-gun was first introduced into Prussia, all those who did not possess it, prophesied its failure in war, and its disadvantages were categorically and incontrovertibly exposed. The introduction of this weapon, and the modification of the tactical training of infantry it entailed, had been ventured upon in Prussia, without waiting for the experience to be gained in a great European war. The enormous advantage in action secured by this measure, can no longer be denied.

The general introduction of sharp-shooters and swarms of skirmishers in 1806, was looked upon not merely as a blow to *tradition*, and a degradation of the grenadier and musketeer, but also as a kind of tactical incongruity, possessing no sort of future. Such examples could be multiplied, proving that *progress* made in meeting the new and increased requirements of warfare, has invariably brought about increased efficiency; whereas nothing but serious disadvantage has ever resulted from a rejection of the necessary improvements. A check of this description, is more likely to have an injurious effect, when supported by one-sided apparent, confirmation, derived from the experience of a successful campaign. The facts of military history are often manipulated in such cases, with a view to obtaining the desired proof. In the great majority of instances, an impartial examination will lead to the conclusion, that results have been obtained *in spite of* and not *in consequence of* certain deficiencies and faults, the retention of which had been considered a tactical duty.

11. *Effect of Opposition to Modern Changes.*—The exclusion of new ideas and requirements, merely because they are new, will inevitably result in deterioration, however strenuous the efforts may be to obliterate the outward visible signs of decay, by means of increased activity.

This taint still clung to tactical science, after the experience gained in the great wars of 1866 and of 1870-71 had been reduced to a tangible form, and some signs of this blight cling to it yet. It is, at all events, impossible not to arrive at this conclusion, when the matter under consideration is closely and impartially examined, both by the light of recorded facts of military history and the *practice registers* of the schools of gunnery and musketry, and of the artillery and infantry ranges.

12. It is not an easy matter for an important branch of the art of war, which tactics may be considered to be, to break with so-called immutable

principles. But this is what must occur, as soon as it is compelled to devote greater attention to the prosaic but practical study of modern fire action, and when it decides no longer to confine its teaching solely to what is laid down in the Regulations. If this branch of tactics neglects to do this, it will have failed in its mission and misunderstood the nature of its duty.

13. *Modern Artillery Fire.*—In connection with *fire and fire action*, which must be considered as the sum and substance of all *tactical principles*, embracing as they do all fighting efficiency, it must be pointed out that theory frequently overlooks the fact in these days, that it is uncommonly difficult, under normal circumstances, even to *initiate* an infantry attack, quite irrespective of *carrying it through*, as long as any important portion of the enemy's artillery remains effective. Notwithstanding the fact, that most works on tactics are the production of infantry Officers, the search for absolute truth regarding what has taken place, and will in the future take place, on the *battle-field*, should not permit us to remain in any uncertainty on the following point, namely, that considering the extraordinary precision of *modern artillery fire*, as compared to that in past wars, an infantry attack, which has to *work its way through artillery fire in its principal phases*, has no prospect of success.

14. If the experiences of '70—71, do not bear this out altogether, they cannot be taken as a guide, inasmuch as the artillery then opposed to us was numerically, technically, and in its organization, greatly inferior to ours. On the other hand, the lion's share in destroying the morale of the enemy's infantry, undoubtedly fell to the *artillery*, and even the German infantry was unable to effect anything *single handed*, whenever the enemy's artillery, which, as a whole, had been overpowered, found itself in a position to act even to a moderate extent. This historical fact should be supplemented by other facts, namely, that the spheres of effective fire action have been extended in these days, that shrapnel has been brought to a high pitch of perfection, and that accuracy of fire, the result of technical improvements, has considerably increased since the Franco-German war. It was found possible to counteract the shortcomings of the Prussian artillery in the war of 1866, by the superiority of the infantry, but notwithstanding this, the Austrian artillery rendered the achievements of the Prussian infantry most difficult on several occasions.

15. The universal teaching, is that battles are opened by an artillery duel. They will, however, in future not only be opened, but also fought out by artillery, through their principal phases. The artillery of the several great Powers, in its present state of development, may be regarded as, more or less, of equal value; at all events, differences in quality, such as existed in 1870 between the French and the German artillery, no longer obtain. The possibility of so completely overpowering the enemy's artillery early in the day, as to drive it off the battle-field, which in 1870—71 was almost the rule, cannot therefore be counted upon any more.

16. The consequence is, that it will no longer be possible to move large bodies of infantry in close formation at even double the *distances*, at which it was possible twenty years ago, and which are still practically adhered to by tactical science. Infantry will, in future, be compelled, when still at great distances from the enemy, either to adopt more supple formations or to extend in lines of skirmishers. The impossibility, in future, of pushing up *large masses in close formation* under artillery fire, which no doubt greatly facilitates the conduct of a battle, does not appear, generally, to have been sufficiently realized.

Modern Infantry Fire.—The same applies to the effect of infantry fire, which has sometimes been considered a secondary matter, results being primarily looked for from a fearless *forward rush*. The Prussian infantry,

at the battle of Kollin, were early taught what it meant to attempt to secure the victory, by rushing forward, unsupported, in the face of infantry and artillery fire, relying *solely* on its own conspicuous bravery. What a vast difference there is, moreover, between the present fire action and that of those times. If the Prussian infantry at Kollin was defeated with a loss of nearly 50 per cent., and if the heroic advance of the 38th infantry brigade on the 16th August, 1870, proved fruitless, similar attempts, in the future, can but result in still more cruel disillusion. When even Napoleon I said "*Fire is everything, the remainder nothing*," it is sheer scientific nonsense to maintain in our day, that the action of infantry is likely to prove successful, if the place, which according to ballistics is due to fire action, be accorded to a dashing advance. This success would not be achieved, for the sole reason that none of the assailants would survive to achieve it. The *object* of fighting is not to experience loss and annihilation, but rather to *gain the victory*. That this is impossible without great sacrifices, amounting even to the loss of entire bodies of troops, needs no further demonstration, and every brave soldier accepts this fact as a matter of course. But under no circumstances, can it be the business of *tactical science* to uphold erroneous views on this point, nor can the action of *leaders* be approved if they expose troops to serious losses in action, without the most urgent necessity. It cannot be considered creditable on the part of commanders, if they rely on the bravery of their troops alone for success, which could have been secured with fewer losses, by means of more suitable and skilful leadership.

17. *Advance under Fire, conducted without Firing, condemned.*—Skilful, and above all warlike, troop-leading must, considering the raised and intensified infantry and artillery fire action, at once renounce adhesion to the teaching which inculcates an *immediate and direct advance* on the enemy, at distances offering a certain prospect of annihilation, without, in return, inflicting any tangible loss. The time is not long past, when troops were required to advance up to 250 or 300 mètres¹ from the enemy, without firing a shot. This was still insisted upon by theorists, as well as by so-called practical men, even after the war of '70-71, notwithstanding the fact that the danger of this theory had been clearly demonstrated by the history of the war. The destructive power of artillery, and the *fire action* of infantry, having since then been nearly doubled, it would now appear advisable to extend in fighting formation and commence the infantry action, at much greater distances than still appear customary. Again, the directions given with regard to taking advantage of the *formation of ground*, which it is presumed will facilitate the approach of infantry to within comparatively short range of the enemy, are only applicable in a minor degree, for the defender will take care to select such positions as will afford him an extensive field of fire. At least, there is no apparent reason why he should not do this, as he will in most cases be free to choose his own ground. It is further an essential qualification of every defensible position, that it should afford no cover for the assailant's advance, and in many cases, as for instance, in Eastern Europe, the general character of the plain is such as not to afford any cover to the attack. Most of the battle-fields of the Franco-German War confirm this view. It would, therefore, appear to be wiser for the assailant rather to accustom himself to reckon with unfavourable than favourable formation of ground, by extending the distance laid down for coming into action.

18. There can be no other *tactical justification* for advancing against the enemy without fighting. It will not tend to unsteady the nerves of a determined enemy, and the assailant's morale and fighting power will not be strengthened as his losses increase. Moreover, it seems a contradiction,

¹ 272—327 yards.

after placing such an excellent long-range rifle as the new arm, in the hands of the soldier, to forbid him to make a suitable use of it. Such a method was justifiable, as long as troops were armed with an inferior rifle. Of course it will be possible even now, under certain circumstances, to advance to within close range of the enemy, without opening fire, though it will always remain the exception. But general principles, should surely not be based on exceptional cases. It will doubtless be argued, that a decisive result can after all only be attained by closing with the defenders, as a determined foe will never permit himself to be driven out of a position by fire alone. This is perfectly true, but a closer inspection will show that the argument has nothing whatever to do with the theory of advancing to close range without firing. The ultimate object of every serious attack, is to *disorganize* the enemy, and an assailant will attain this object much sooner if he commences an effective fire at long range, than by reserving his fire until within short range, after having himself experienced the demoralizing effect of the enemy's fire during his advance.

Why should a body of troops, weakened both physically and morally, be supposed to have better chances of getting up *sooner* and *nearer* to the enemy, than another, whose advance is carried out under considerably more favourable tactical and moral conditions? This theory might hold good against an enemy, inferior both in shooting power and bravery.

Tactical principles cannot, however, be based on such one-sided considerations. It should always be assumed, that the enemy is of approximately equal quality. For it would otherwise be both impossible and superfluous, to reduce the lessons of war to more or less rigid principles, if it were taken for granted, that owing to the enemy's inferior moral qualities, it would not be necessary to adhere to them. The *science of tactics* cannot be permitted to consult highly coloured and fantastic accounts of battles.

19. The foregoing endeavour to show that the probability of success is diminished, by forming a low estimate of fire action—the finally decisive factor—might perhaps lead to the conclusion, that the defensive must be the more effective method of fighting, owing to its tendency to favour fire action to a greater extent than the offensive.

Preference to be given to the Offensive.—Such a conclusion would, however, in a general sense be a false one, and the preference should certainly be given to the offensive in every form, nevertheless, *the manner in which the relative merits and demerits of the offensive and defensive are frequently set off one against the other, by tactical science and battle leading respectively*, cannot be approved of. It was laid down by Clausewitz, that the defensive was theoretically the more effective method of fighting, and well knowing that a pure defensive could never produce decisive results, he recommended a combination of both forms, the so-called defensive-offensive. As a matter of fact, every engagement between evenly matched opponents assumes this character, for the varying phases of battle require corresponding changes from the offensive to the defensive and *vice versa*. On the other hand, the adoption of either the attack or the defence, is the direct result of the strategic situation, and this fact alone, persistently imparts to an action a general defensive or offensive character. Hence the difficulty of carrying out this theoretically more effective defensive-offensive method of fighting; notwithstanding the existence of a general conviction that the defensive should only be adopted in special cases, with a view firstly to compelling the enemy to deploy and fight under disadvantageous circumstances, and secondly to attacking him, thus passing to the morally more effective form of combat.

Notwithstanding the introduction of the balloon and field telegraph, commanders are not now able to decide upon the proper moment for passing from the defensive to the offensive, with the same ease and certainty as

formerly. This fact is due to the smaller area then occupied by armies in action, and to the closer proximity of opposing forces. It may be fairly deduced from the above, that apart from the changes from the defence to the attack and *vice versa*, at certain points in the fighting line, the action as a whole, will always assume either a decided defensive or offensive character. This is borne out by military history, and even in the case of encounters between forces on the move, the choice between the offensive and defensive is not absolutely unrestricted. The side which first adopts the strategic offensive, will be able tactically to dictate to its opponent, and compel him to adopt the defensive.

20. *Modern Improvements a Gain to the Defence.*—The fact, based on the experience recorded in military history, that the offensive, both strategic and tactical, offers the best guarantee of success, in no way absolves tactical science from the duty of clearly demonstrating the greatly increased difficulties of the attack, and the advantages which have accrued to the defence, by the improvements effected in the means both of destruction and protection. The more thoroughly and impartially these points are examined, the clearer do the considerations stand out which must *regulate* the attack, if its difficult task is ever to be successfully accomplished. The accomplishment of a difficult task, is not facilitated by relying solely on courage and determination. These, should be supplemented by a thorough insight into the difficulties of the situation, otherwise the measures adopted will rarely prove successful. As the difficulties of conducting an action increase, and the destructive power of technical factors makes itself more intensely felt, the greater becomes the commander's responsibility of rendering himself familiar with these circumstances, in order that he may remain cool and collected under the disturbing influence of unexpected events. It is the duty of tactical science, minutely to analyse the actual procedure in action, in order to elucidate the intricate connection existing between cause and effect. This honestly carried out, will inevitably lead to the conviction, that very great importance should be attached to the efficacy of the defence, a fact well established, both scientifically and by the rough usage of battle. Those who still prefer the attack, will be enabled, by a clear demonstration of this incontrovertible fact, to approach the solution of this most difficult problem without illusions. Many a stereotyped tactical example will then be swept off the training ground, the existence of which, can only be explained by a failure to grasp the impossible nature of the demands, which might be put forward by an imperfectly developed tactical science, and the disillusion which a practical application of its teaching would entail in war.

Such disillusion injure the moral value of troops, and diminish their confidence and self-reliance. They should therefore be avoided as much as possible. Tactical science, which declines to be influenced by the prevailing views of the moment, which neither looks to the right hand nor to the left, but strives solely and straightforwardly to discover the *true nature of things*, will always seek to eschew such experiences. It will further endeavour to clear up all doubts as to the best ways and means of securing to the attack superiority in modern warfare, in spite of all difficulties, and will strengthen the *consciousness* of possessing the power to overcome the mechanical superiority of the defence. This, however, comes more properly under the head of battle training, and will therefore be dealt with elsewhere.

21. *Fighting in Successive Lines.*—As regards the system of *tactical subdivision of troops in action* (Gefechtsgliederung), it should be pointed out that the notion of forming up in successive lines (Treffentaktik), which belongs to days long past, does not as yet appear to be entirely eliminated from tactical science. Even on the battle-fields of the Seven Years' War, but few traces of such tactical formations are discoverable. In any case, everything

which since that time has been either devised or practically executed on the drill-ground, with regard to the detailed employment of each successive line, to the several lines passing through or relieving each other, to their attack in échelon, &c., and more especially to their *independent* use, comes under the category of fancy formations, which are of no value whatever in action. There was also a time, when it was proposed to employ cavalry in accordance with the so-called "three line formation" (*Dreitreffentaktik*) derived from the days of Frederick the Great. A closer examination, however, disclosed the fact that the action of the Prussian cavalry in this artificial formation proved anything but effective on the battle-field, and it is due to this, that the Prussian cavalry regulations have laid it aside. The centre of gravity has, as it were, been transferred to the first line, and too much is no longer expected, in the way of decisive action, from the rear lines, at least against cavalry.

22. Fighting in successive lines (*Treffentaktik*), is now obsolete for infantry. Considering the effective character of modern armament, an advance in this formation, would be unsuitable in action, if for no other reason, than that every effort is now made to obtain the greatest possible fire action, and this can only be developed by the leading fighting line. The losses, however, which this line will sustain from the very commencement at long ranges, will be so severe, that the lines in rear will be precluded from taking any immediate part in the conflict, as immediate supports to the *real attack*. Formerly, when it was still possible to retain the rear lines comparatively close up to the fighting line, they remained sufficiently intact to support and reinforce it, and could reach it, in more or less close formation, without suffering too severely. This was due to the limited extent of the fire zones to be traversed by both the leading and rear lines. Those were the days, when it was possible to bring up large masses under cover of the leading fighting line, for the purpose of dealing a decisive blow. Owing to the necessity, already referred to, of commencing the infantry action at greater distances than formerly, the danger zone to be traversed has become so extended, that there is now no prospect of the rear lines being able to reach the enemy, in any formation which would admit of *independent* decisive action. The lines in rear, will no longer be in existence as such, by the time the crisis supervenes. The infantry fight will resolve itself into a prolonged and costly struggle, necessitating the bringing up of the rear lines. Their rôle will be to feed the fighting line and replace the waste, thus becoming mere sources of supply. To such an extent will this be the case, that by the time the actual crisis arrives, mere fractions of the original lines will be remaining to support the final attack.

23. The absurd idea, of attempting to decide the issue by attacking with masses of troops brought up from the rear in close formation, must needs suffer considerable modification. Firstly, because the required masses will not be forthcoming, having been dissolved in feeding the fighting line, and secondly, because it will be quite impossible for these masses to traverse the fire zone.

Such attacks are condemned by the history of the last war. Attempts of this nature will invariably end in failure, whenever the opponent retains even a minor degree of resisting power, and the ground does not permit the assailant's supports and reserves to approach under cover. Towards the close of modern battle, the infantry in the assailant's fighting line will have suffered so heavily, and will be so disorganized after having more or less succeeded in silencing the defender's guns, that it is *doubtful* whether its remaining fighting power, will be sufficient to carry it forward to the final assault, even under the influence of some unusual stimulus.

Objection will probably be taken to the *doubt* expressed. But military

history must again be appealed to. At the battle of St. Privat—Gravelotte for instance, notwithstanding the preponderance of the German Army in infantry, and more especially in artillery, it was found impossible to *break through the enemy's line* at any single point, by means of a *frontal attack* of infantry, unsupported by the other arms. The circumstances are identical at the battles of Spicheren and Wörth.

24. *Infantry Frontal Attack.*—Notwithstanding the superior co-operation of artillery and the most determined bravery, the frontal attacks of infantry, formed in several successive lines, failed on those occasions to produce any *decisive* results. It was only pressure on the enemy's flank, or a marked numerical superiority, or even the defencelessness of the enemy's infantry when opposed to the fire of our artillery, which actually effected, what the various battle accounts ascribe to the frontal attack of infantry. Infantry will in future continue, as heretofore, to claim the privilege of opening up the path to victory with its heart's blood, but, considering the destructive power of modern armament, it seems too much to expect, under normal circumstances, that any decisive effect could be produced by the unaided frontal attack of infantry. Such an attack implies, in most cases, sacrificing the infantry without any certainty of ultimate success.

25. The secret of victory must be looked for in the operation of other factors, but in any case, not in a cut and dried conception of the rôle of infantry in battle, making little or no allowance for the action of *moral* forces, which in reality, exert a decisive influence.

26. *Employment of Reserves.*—*Tactical science* is often insufficiently explicit in determining the composition and capabilities of the several lines or échelons. The same is the case, as to the employment of *reserves*. It is mostly taught, that the object of reserves is to be employed in bringing about a decisive result at any given point. This, of course, is self-evident. In settling this question, the point arises, as to whether the action of the reserves should be in the form of *pressure* brought to bear on the rear of the fighting line, as was the case in the old formation in several lines, or whether its action should be of an independent character, on any particular part of the battle-field, where, though tactically applied in threatening the enemy's flank or line of retreat, it would also have a strategic effect on the whole situation.

The employment of the reserves in the manner first indicated, no longer promises to be successful, except in special cases, where the enemy has become so disorganized as to have lost all power of fire action. Such results would, however, be rarely attainable.

27. At the battle of St. Privat—Gravelotte, the IInd Army Corps, acting as a reserve, was launched into the fight, with every prospect of success, towards the close of the battle, against an enemy who had been engaged for hours, without producing any decisive effect. And yet in this instance the assailant, who kept up the fight until the reserves were brought up, was greatly superior both in infantry and artillery.

The dissolving effect of modern fire action, is strikingly exemplified on the right wing of the assailant in this battle. It is only necessary to refer to the fights about St. Hubert, where, at the end, although as many as forty-four different companies were found to be intermingled and in some cases entire units had become dissolved, the results obtained, were not proportionate to the losses sustained. The assailant, notwithstanding all his efforts, never actually succeeded on this part of the battle-field, in reaching the defender's *main fighting line*. There would be no difficulty in quoting other examples of the kind from the pages of military history.

28. It is therefore quite clear, that neither the action of successive lines, nor the mechanical pressure of the reserves, will ever suffice in the battle of the future, to secure any decisive result to the assailant. Neither the devo-

tion of the troops, nor the energy of the commander, will alter the case. A comparison of the tactical results obtained in the campaigns of 1866 and 1870, is of great interest in this respect. In 1866, it was still found possible in several instances, to obtain tactical results by means of frontal attacks, prepared by the assailant's rapid fire, and supported by the rear lines or reserves. On the other hand, such attacks failed when attempted in the face of the rapid fire of the needle-gun. In the war of 1870, the situation is essentially different, inasmuch as the identical troops, who in 1866 were able to carry out frontal attacks with comparatively large bodies, when supported by superior fire action, failed to obtain similar results when adopting similar tactics against an enemy whose fire action, thanks to the breechloader, was fully developed.

Tactical Turning Movements.—In 1866, attempts at genuine tactical turning or enveloping movements were practicable. In 1870, only very few proved successful. Tactical envelopment is, on the whole, nothing more than a surviving remnant of an obsolete tactical science. The flanks were formerly far more exposed than they are at present, owing to the fact, that the enemy could always approach sufficiently close to threaten the entire fighting line. The assailant's approach to the weak points in the defence, acted unfavourably on the morale of those whose position was being turned. Now, however, flank attacks of this description can be met by fire and kept under fire, at such a distance, as will eliminate the elements of suddenness and surprise. The compact fighting line of former days, stood in serious danger of being rolled up by a flank attack. This danger is greatly diminished, now that a close touch is not preserved in the fighting line, quite apart from the fact that the extent of ground swept by the defender's fire is so increased, that he would have sufficient time in most cases, to carry out suitable counter-movements.

29. As regards the further employment of reserves, that is, of comparatively large masses of troops retained for the purpose of delivering the final blow at the decisive point, tactical science still frequently leaves it optional, whether this blow should be aimed at the centre or at a flank of the enemy's line. This idea, is handed down to us from the Napoleonic wars, in which repeated cases of thus breaking up the enemy's line, undoubtedly occurred. It is time, however, that this plan be finally excluded from tactical science, for an operation of this kind eventually resolves itself into a frontal attack, supported by the pressure of considerable bodies of troops in rear. The hopelessness of such a task, needs no further demonstration. It would therefore, be only consistent to lay down, once and for all, that the scale of battle can in future, be turned solely by operating against one of the enemy's flanks, the object being, to seize on some unprotected point, preparatory to piercing his fighting line, and paving the way to victory by destroying his morale. This conclusion is not based on theory alone, but is fully corroborated by the records of recent wars.

30. *Formation in Depth.*—Tactical science, attributes great importance to troops being formed up with the greatest practicable depth, and to their fighting in a deep formation. The principle underlying this theory is right in itself. It is based on the necessity of economy of force, and on the justifiable desire to retain control over the troops, as long as possible. It is also supposed to tend towards the prevention of dispersion. It must, however, be urged against this theory, that formations in depth, ensure a plentiful and easy harvest to the enemy's fire, and more especially to that of his artillery. Artillerymen declare candidly, that they could wish for nothing better than a deep infantry formation. It should besides be borne in mind, that the principle of deep formations is inconsistent with the demand, that the fullest possible use should be made of fire action. Superiority of fire action, can only be attained by the deployment of extended lines, enveloping the enemy as

far as possible. This, however, does not coincide with the aims of a deep-fighting formation. What has been enunciated, undoubtedly applies more to the attack than to the defence. Fighting in depth is obviously much easier for the latter, and is, on tactical grounds, well worth endeavouring to carry out. At all events, we appear to be face to face with an academical question, which, with regard to modern warfare, cannot be settled off-hand by giving the preference, *on principle*, to the deep-fighting formation, without taking into consideration, that the danger of never obtaining a decisive preponderance in the development of fire and in fire action is thereby greatly increased, owing to a *piecemeal* deployment of force.

31. *Superiority in Battle Training and Leading essential.*—If, in accordance with all that has been advanced, perfected fire action has rendered the attainment of any tactical success so extraordinarily difficult, and if victory or defeat be finally dependent on superiority in battle leading and battle training—two mental factors—it must not be supposed, that the value of tactical science is thereby in the least diminished. Superiority in troop leading, will always remain one of the main conditions of success, and may, under certain circumstances, even lead to victory over an enemy of *superior morale*, as, for example, in the campaigns of 1794—1796. But no modern army, would be content with exacting the utmost from the commander, and with requiring less from the tactical efficiency of the troops. Considering that in these days, any important differences of opinion on the science and art of war, even of a theoretical character, no longer exist, in other words, that a superior conception of the nature of war and its requirements, is no more to be looked for in any particular army, every effort should be made to arrive at lucid, precise, tactical views, so as to be able rightly to shape battle training—in which it is far easier *in time of peace*, to work with known quantities, than when dealing with the art of war—to further it, and to introduce a certain cunning into its execution, in order to secure, as far as possible, *superiority in battle leading and fighting efficiency*.

32. In the face of the vast progress which is being made in every sphere of military life and effort, the fact that an army has hitherto proved itself superior in battle training and consequently in fighting efficiency, to those of other nations, cannot relieve it of the responsibility of continuing to improve itself with persistent energy and, what is quite as important; without *anxiety* or overstraining.

33. *General Considerations governing Battle Training.*—Only general considerations, by which the battle training of infantry might be governed, will here be referred to. Part II of our Infantry Drill Regulations, may be taken as a guide, in *tactical science* as well as in *battle training*. Yet, although only a period of two years has elapsed since their issue, the ceaseless progress of technical sciences has developed fire action to an extent, which it was impossible to foresee and provide for. It is only quite recently, for instance, that we have heard a professional exposition of the influence of smokeless powder on the action of artillery in battle—one only, of the many technical triumphs of recent years—and the exclusion of the due consideration of the demands made by the changed, or rather intensified, *realities of battle* as affecting infantry, was considered to have done violence to the subject.

34. The German infantry is guided by two principles in their battle training, and the increased requirements of to-day will be met, if these continue to be *logically expanded and thoroughly applied*. They are, firstly, the fundamental principle, that the *fighting formation of infantry* is the *extended line*; and, secondly, that the training of the soldier should be *adapted to the requirements of war*. It follows from the former, that the *action of the extended fighting line*, is the foundation of the course of training and the aim

of all instruction. An improved system of *musketry training*, furthered by all available means, should therefore assume a prominent place in the soldier's training. The scope of musketry training will in future have to be greatly extended, developing fire action to the utmost, and at the same time taking fully into account the effect which may be considered justly due to the enemy's fire. Infantry Officers, will also have to render themselves more familiar with the fire action of artillery. They will have to visit the artillery practice grounds, not with a view to being intimidated by seeing the effect of shrapnel and shell fire, but in order to observe for themselves the nature of artillery fire action, so as to know how to take it practically into account on the field of battle.

35. It cannot be denied, that the greatest importance was formerly attached to training in close formation, a view unsupported by warlike experience for years past. No doubt whatever now remains, that individual action and the fullest development of the use of the rifle, are the end and aim of the infantry soldier's entire training. This result, moreover, is not due to concession to public opinion or theoretical conclusions, but rather to the inexorable teaching of war practice. Those who refuse to admit this fully, are nothing but unfruitful theorists, who are behind the times in their conception of infantry battle training, the nature of which, moreover, is diametrically opposed to war experience. They further place themselves in direct opposition to the guiding principle authoritatively laid down, which may not be trifled with, and which should be the fundamental rule governing the entire course of training, from the day the recruits join to the period of field manoeuvres, namely, that *training, instruction, and practice, must conform to the actual requirements of warfare.*

36. *Field Fortification.*—Training will have to take into account much more than heretofore, the altered requirements of the modern method of fighting, with regard to making the *fullest use of field fortification* on the battle-field, and also with regard to *night fighting*, which promises to take a prominent place in the operations of the future. Any neglect of these points, especially in making the fullest possible use of field fortification in the attack, as well as in the defence, will in all probability be severely punished. This obligation, cannot be fulfilled by seeking to base the entire training, mainly on the offensive. This would cause the warlike training, of both troops and commanders, to remain incomplete. The *offensive spirit* of an army, need not be injuriously affected by the training suggested, if carefully imparted. An army which, owing to the complete character of its training, is equal to all possible emergencies, will be in a position to solve even the most difficult problems in battle, with greater ease and readiness, than an army whose training has been of a one-sided nature.

37. *Mere External Uniformity Worthless.*—Amongst the worst enemies of a sound warlike training, is the desire to secure a superficial, pleasing uniformity, by means of formations and deployments, which in themselves are unsuitable and impracticable in modern warfare, and therefore, actually misrepresent the *true nature and course of battle.* Such order and uniformity as can only be maintained when bullets are *not* flying about, are of no practical value. They not only present to the rank and file, false pictures of what really occurs in action, but also leave false impressions on the mind of the commander, tending to hinder him in the performance of his duties, in two ways. Firstly, in conducting the training of the men, for if he does not himself possess a clear grasp of the actual requirements of battle, it is impossible for him to impart a really practical battle training. Secondly, in completing *his own* training, for it is during the peace training that the commander should acquire perfect familiarity with the difficulties of command in action, in order to guard against surprise and confusion, when

exposed to the disturbing effect and surrounded by the realities of battle. Most men, become neither wiser nor more sagacious in the turmoil of battle, rather the reverse. The possibility, therefore, of correctly perceiving, at the moment, what measures and formations are required during an action, should not be relied upon. The entire training, should rather be so arranged and perfected, that *each individual combatant may thoroughly master the actual procedure in action.*

38. *Disorder in Action.*—Disorder, will become one of the most characteristic features in the battles of the future. The breaking up of units, the lack of commanders, the depression due to the losses experienced being sustained within a much shorter space of time than heretofore, will render the maintenance of either order or connection unusually difficult in the actual fighting line. These difficulties have now reached such a pitch, that it can only injuriously affect the training, if consolation is sought from the supposition, that matters will not in reality look so grave, if only strict discipline is instilled into the men in time of peace, and they are trained to push on with dash. This view of battle training, prevails chiefly among Russian writers. It is a thoroughly one-sided view, and its practical application in the furnace of modern battle, promises but little success. This idea of the nature of battle training, is nothing more nor less than ingenuous, but however chivalrous it might appear, battles have never yet been won by ingenuousness.

39. The disapproval expressed of the idea, that it is still possible in the present day to maintain sufficient *order and connection* in the actual fighting line, to admit of a systematic and deliberate performance of the functions of command, applies equally to the endeavours made (at the cost of misrepresenting the true course of battle) to favour formations and deployments which, though *conducive to order*, are *not in accordance with war practice*. The soldier's eye should be accustomed and regularly trained in time of peace, to look upon straight lines, good direction and covering (formerly not only admired, but considered absolutely essential), as a positive evil when connected with *battle training*, and solely for the reason, that they are incompatible with warlike training and warlike performance. This new habit, will doubtless be found irksome on æsthetic grounds alone, but the duty of acquiring this change of habit and thought, becomes more than ever imperative, as without it, tactical views and battle training fulfilling modern requirements, are not attainable. *Exercises illustrating order*, belong in future exclusively to the drill-ground and the parade-ground. On the other hand, unswerving efforts should be made to maintain only *such order* during battle training, as it will be possible to retain *in action*. This can only be effected by means of stern discipline and strict training. It is not intended to dwell any further on the increased demands, both in quality and quantity, now made on the well-trained soldier and the capable leader (referring specially to the Officer). In judging the relative merits of commanders, it was perhaps justifiable formerly, to attach special value to the ability they displayed on the parade-ground; but nowadays, *skill in conducting the battle training of troops* should be considered first and foremost, then the actual results produced by the training, and lastly individual dexterity in troop leading. If a commander exhibits a tendency to train his men up to the standard of the parade-ground, rather than up to that imposed by the exigencies of battle, he must be regarded as simply failing in his *principal duty*, that is, of imparting a warlike training.

40. *True Warlike Character of Training essential.*—The absolutely imperative nature of a warlike training, of the soldier as well as the Officer, has been thoroughly recognized and clearly laid down by our new Drill Regulations. They express a warning, in unmistakable terms, against the employ-

ment of *stereotyped examples* in tactical exercises. These cut and dried forms, even in the days of muzzle-loaders, interfered more or less with warlike training, though they still possessed a show of reason, as long as it was really possible to approach the enemy in close formation to within 200—300 metres.¹ In the present day, there is not the smallest justification for the employment of these stereotyped forms. They would not only be detrimental to the battle training of the troops, but would be directly opposed to the clearly-defined intentions of the Regulations.

41. *Frontal Fight in Fixed Order of Battle, more important than Independent Operations of Small Bodies.*—The condemnation of the employment of stereotyped forms in the training of troops for battle, applies in principle, to the tactical manœuvres of larger bodies, in so far as they do not take sufficient account of the actual circumstances of war. It should not be overlooked, that owing to the huge masses of troops assembled on the battle-field, and the consequent limited amount of available space—according to the experience of the last great wars the average fighting space allowed to one army corps is from 3,000 to 4,000 metres²—the character of the fighting will be more that of the so-called “pitched battle,” than is generally the case during peace manœuvres. Fighting on a smaller scale, with detached mixed forces, will in future be the exception, whereas the more or less fixed order of battle, the *frontal fight*, will become the rule. Consequently battle training should tend more towards preparing troops (both men and commanders), for *fighting in a fixed order of battle*, than for acting as independent bodies. Dexterity in the former, will be productive of by far the most brilliant results, for the great decisive blows are dealt in great battles, entailing heavy losses, and not in the operation of independent bodies of troops, which, under certain circumstances, may not amount to more than a division. It was not until *after* the fall of the Empire, in the war of 1870-71, that independent divisions, or even smaller bodies, came to be employed. The use made of smaller mixed forces, was hardly worthy of mention before that time. The requirements of this description of warfare should still, now and then, be taken into account in the course of training, with the object of affording commanders opportunities of exercising self-reliance. But a higher value should undoubtedly be placed on their ability to deal with the problems encountered when fighting in regular order of battle. The objects of *training* resulting from this, are clearly defined, and are mostly confined within certain narrow limits. This fact will rarely prove agreeable to the desire for action on the part of Officers and Commanders, but is nevertheless in harmony with the realities of war. The object of training, is not to promote that which is either convenient or pleasant, but solely that which is consonant with the exigencies of warfare.

42. *Technical and Numerical Superiority no longer exists in any one Army.*—The requirements from both Officers and men, have increased with such rapid strides in the midst of the general competition prevailing in all matters relating to war, that it will not be out of place to bring them comprehensively under review. As conscientious soldiers, we must frankly face the fact, that a spirit of feverish activity is ruling in every army, and that technical or numerical superiority will hardly be found to exist on any particular side in the next war.

43. *Fighting Power to be Developed.*—The responsibility in *training* troops, becomes all the greater under these circumstances, and all concerned should do their utmost to promote their training, so as to enable them to retain the victory in this competition. What has been said on this subject, may be

¹ 218—327 yards.

² 3,270—4,360 yards.

briefly summarized thus : that the invariable object to be kept in view by tactical science and battle training, is the improvement and strengthening of *fighting power*. This embraces the *intelligence of the commander* as well as the efficiency of the troops, for a force applied in a wrong direction remains *inoperative*. Raised fighting power alone, will admit of decisive results being obtained in the face of modern fire action. Superior *fighting power* alone, will allow of strategic operations being undertaken with inferior numbers, in order that superior forces may be brought to bear on the decisive point. It alone, will render it possible to exhaust the opponent's fighting power, to adopt the offensive, notwithstanding the incontrovertible mechanical superiority of the defensive, and finally, tactically to apply at any given point the superiority gained, as in warfare on an extensive scale.

44. Superior *fighting power*, resulting from the warlike training of both Officer and man, from earnest and incessant training in discipline, sense of duty, pride of arms, and patriotism, offers the only guarantee, in spite of all improvements in the means of destruction and protection, of being able to cultivate the *spirit of the offensive* in the art of war and tactics, and eventually of crowning this spirit on the battle-field, with the *successful delivery of the attack*.

45. Superior fighting power thus produced and retained as the permanent heritage of an army, is the secret of success. In the hands of Commanders like Frederick the Great, Napoleon I, or those produced by Germany in the last great wars, this power will be developed to such a degree of warlike efficiency, that posterity will record the fact with wonder.

46. *Examples of Superior Fighting Power.*—The following examples from military history will serve to show the decisive importance of fighting power, resulting primarily from a *true warlike training of both troops and commanders*. At the battle of Auerstädt the Prussian Army, though double the strength of the French forces, was unable to secure the victory, notwithstanding its superiority in external discipline and drill. The French corps of Davoust excelled the King's army in warlike training and education. It was further superior to it, in warlike leading and true warlike bearing. The Prussian attacks proved abortive owing to the superior *fighting efficiency* of the French. At the battle of Mars-la-Tour—Vionville, we see the IIIrd Army Corps engaged for hours, in a heroic struggle against overwhelming odds. It had been trained, instructed, and led by its commander, Prince Frederick Charles, during a period stretching over many years, in a true warlike spirit and system. *In time of peace* he encouraged all the mental, moral, and technical elements of true soldierly training, by means of practical, persevering work, in consequence of which, it was able to exert greatly superior fighting power to that of the enemy, and the King was thereby enabled to carry out brilliant plans, which would otherwise have been impossible of execution.

47. *The highest attainable Results to be Aimed at in Training.*—Even with the most thoroughly warlike and careful *individual training* of the soldier, fighting power will only be fully developed, when ample scope is given to *moral and mental factors*—the immutable foundations of all military achievements—by causing the *training as a whole*, to aim at the highest possible results. The quality of the training is dependent on the judgment of those to whom it is entrusted. It should, therefore, be the aim of all upon whom this important duty devolves, to seek to enlarge their minds, to strive and labour to remain always on the alert (*"toujours en vedette,"* to use the words of the Great King Frederick), in their daily duties, as well as in the further development of their own training, to sharpen the weapons of the *mind*, by which they will in future be able more than ever to acquire professional skill, and which have always hitherto secured the victory over *matter*.

GERMAN INFANTRY RIFLE, 1888.

FIG. 1.

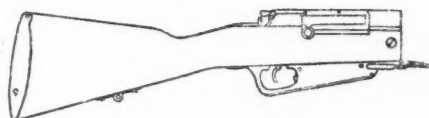
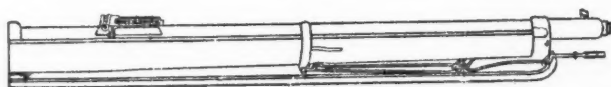
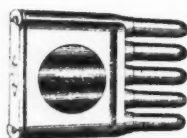


FIG. 2.



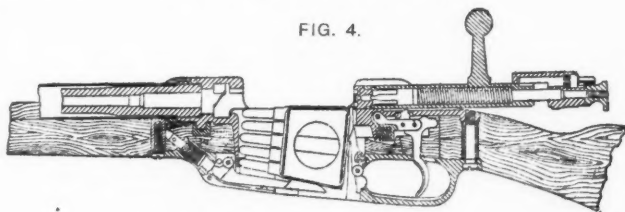
"MUZZLE END AND BREECH END OF THE BARREL JACKET."

FIG. 3.



"METAL FRAME, HOLDING FIVE ROUNDS."

FIG. 4.



"SECTION OF BREECH ACTION, WITH CARTRIDGE FRAME INSERTED."

THE MOST RECENT ALTERATIONS IN THE GERMAN INFANTRY DRILL REGULATIONS.

By Major W. H. SAWYER, North Staffordshire Regiment, Brigade Major
1st Brigade, Aldershot, 1st March, 1890.

WITH a thoroughness and forethought worthy of a great nation whose very existence depends upon the soundness and efficiency of its armed strength, the Germans, in anticipation of the rearmament of their troops with the new Mauser small-bore, Fig. 1 (officially known as "Infantry Rifle '88"),¹ have already brought their Infantry Drill Regulations, published in the autumn of 1888, up to date.

Instead of issuing the corrections as usual in the form of "slips," printed on one side only for facility of insertion, knowing the inconvenience of this practice in the case of a book in constant use and anxious to spare their hard-worked soldiers any unnecessary trouble, they preferred to issue a new edition, dated 1889.

The closing words of the lecture delivered at the R. U. S. Institution in April last, on the "Recent Changes in the Drill of the German Army," have come true. The German military fighting machine has once more been readjusted and fitted for the performance of its ever-changing work, and, without claiming the gift of prophecy, we may continue to rest assured that it will not fail to be readjusted again and again when the proper moment arrives.

Cause of Alterations.—The alterations made in the Infantry Drill Regulations are mainly due to the introduction of the new rifle, and the Musketry Regulations of November, 1889, which replace those of February, 1887. Though not numerous, they constitute an important step in developing the efficacy of fire action.

Nature of Alterations.—Most of the alterations are to be found in Part I, The School; only six in Part II, The Combat;² and none in Part III, The Parade, &c. From this may be gathered, that the changes affect matters of detail only, not of principle; and, further, that the details revised are not of an immaterial nature, such as are connected with show parade movements, salutes, &c. All these points were carefully dealt with in the 1888 edition, and probably finally so, at least for many years to come.

Reduction and Simplification of Regulations.—The same spirit which caused the systematic and logical recasting of the Regulations of 1888, to which attention was called in the lecture already referred to, has again been at work, resulting in a further reduction and simplification, though very little of either was required.

Loading and Ammunition.—The simplified method of loading has brought

¹ See Appendix I.

² Alterations to be obtained at E. Stanford, 26, Cockspur Street.

³ "Infantry Rifle, 1888"—*Loading and Unloading.*—The metal frame, containing 5 rounds, when dropped into the breech, is held down by a spring catch. Another spring underneath prevents it from falling through (as long as it contains any rounds) by an upward pressure on the lower round. When empty, the frame drops out. The rounds are brought into position by opening and closing the breech block. A filled frame is removed by opening the breech and releasing the catch, the up-

about a reduction of five, in the number of paragraphs contained in Part I, which now consist only of 224.

The ammunition¹ is now served out in light metal skeleton cases, holding five rounds, Fig. 3. These are inserted bodily into the breech, and single rounds are no longer handled by the men. Besides simplifying the manipulation of the rifle, Fig. 4, and increasing the rapidity of firing, this plan tends to preserve the ammunition, facilitate its distribution, and certainly shows the reliance placed in the men's discipline and self-control in action. No stone is left unturned to make the soldier intelligent and trustworthy, after which he is rewarded with the confidence of his superiors.

Barrel Jacket.—The first alteration that meets the eye is the substitution of the word "Laufmantel" (Barrel jacket) for "Lauf" (Barrel). The barrel of the new arm lies inside a steel cylinder, Fig. 2. The objects given for this arrangement are :—

1. To protect the barrel from accidental injury.
2. To allow of its uniform vibration on firing and expansion on heating, which are injuriously affected by—
 - a. Welding on of sights.
 - b. Pressure of bands.
 - c. Warping of stock.
 - d. Fixing on of bayonet.
3. To protect the hand, when the barrel becomes overheated by rapid firing.

Infantry Drill Regulations, sole authority on Fire Leading and Discipline.—The German Musketry Regulations confine themselves to teaching the recruit all about his rifle and how to use it, and the trained soldier how to keep up this knowledge and perfect himself in it. But they are not considered to be the sole repository of musketry wisdom, and are not permitted to absorb all instruction on the tactical application of this knowledge. This is not looked upon as "departmental lore," but rather as the common property of all soldiers and their everyday instructors and commanders who are entrusted with their battle training. Hence all instructions regarding fire leading and fire discipline have been removed from the new Musketry Regulations, which mention these points (para. 161) merely to refer the reader to the Infantry Drill Regulations, §§ 130, 132—136).

The following are the main alterations as to firing :—

Firing Position—(§ 66) *Lying Down.*—Great importance is attached to resting the rifle, if possible, on some object when firing lying down. The point of support with the new rifle is stated to be between the upper and lower band. The left hand grasps the butt near the toe and presses it into the shoulder, the right hand as usual. When firing at long range (over 1,000 m.) the rifle rests on the part below the lower band.

Kneeling Down (§ 67).—This is done either on one knee or on both knees. When on one knee, it is left optional whether the left elbow should rest on the left knee. When firing at long range, the butt is placed against the breast, but it was formerly stated that the position of the left hand could not be laid down. Now it is directed that it should grasp (the box of) the rifle in front of the trigger-guard.

Firing from behind Trees (§ 68).—Any possible misapprehension as to

ward pressure of the spring driving it out. It is possible to insert single rounds into the barrel, but only permitted under very exceptional circumstances.

¹ See Appendix II.

the real value of cover afforded by trees, is removed by the explanation that even if sufficiently thick to stop a bullet, it can only give cover from fire directed from the front and not from the flanks.

Firing from behind Breastworks (§ 69).—Formerly the soldier was ordered to lean with his left side against the interior slope, when firing from a breastwork. This is now left optional. The rifle can thus be held as described in firing lying down with the rifle supported.

How carefully every word of these Regulations has been weighed can be seen from the substitution of the word "should" for "must" in the following sentence (§ 74)—"Every soldier should be trained, as a rule, to seek to obtain results by careful aiming and deliberation, rather than by rapidity of fire." To this paragraph is added the new sentence—"The soldier must, however, be able to deliver single shots, as well as several in succession, with rapidity and certainty from any position.

Description of Fire.—The different descriptions of fire remain the same, i.e., zug or company volley and independent firing.

Independent firing is now divided into slow, ordinary (*lebhaftes Feuer*), and rapid firing.

It may be interesting to note here, the German view of volley firing.¹ They maintain that—

- (1.) It enables troops to be kept better in hand.
- (2.) It is easier to observe where the bullets strike, and thus to ascertain the range.²

On the other hand, that it is difficult in close formation to hear the word of command in the noise of battle, and only possible in extended formation on rare occasions, and, therefore, that its use will be restricted to the commencement of an action and to those movements in which troops are not under effective fire.

They hold that independent firing will be the rule in extended formation, and that it possesses the advantage over volley firing, of enabling the individual soldier to aim with deliberation and to await the most favourable moment for firing.

A zug, company, or battalion on the march may halt and fire volleys at cavalry (§ 94), and it is pointed out that, as the men may not all be equally prepared to fire (owing to some of the cases having been partly emptied

¹ *Simultaneous Employment of different Sights* (Musketry Regulations, 1889, § 159).—Only one sight should be used in firing up to 800 m. (872 yds.). Over 800 m. two sights, differing by 100 m., will, as a rule, be used simultaneously, which, according to Musketry Regulations, 1889, § 156, will sweep 200 m. (218 yds.) of ground. As soon, however, as the actual range can be obtained, only one sight should be used. The front rank fires at the shorter range, the rear rank at the longer. No advantage is gained by using two sights, if the body of troops firing is less than a zug.

² *Ascertaining Range by Volley Firing* (Musketry Regulations, 1889, § 162).—This can only be done when—

- 1st. The ground immediately in front of the object is visible.
- 2nd. The object is stationary.
- 3rd. The nature of the ground admits of the striking of the bullets being observed.
- 4th. The men firing are not under effective fire themselves.
- 5th. The time necessary for thus ascertaining the range is available.

These conditions will but rarely be fulfilled simultaneously. This point need, therefore, only be considered in exceptional cases.

while others remain filled), if the volleys are delivered in rapid succession, it may happen that some of them may be unable to take part in the firing.

Range Increased at which Fire may be Opened.—The ranges at which troops are to open fire have been extended, so as to make fuller use of the increased precision and range of the new arm.¹

	Now.	Formerly.
(§ 96.) At retiring columns of infantry.	900—1,000 m. (981—1,090 yds.)	650—750 m. (708—817 yds.)
(§ 130.) At artillery in action	1,000—900 m. (1,090—981 yds.)	800 m. (872 yds.)

Artillery is no longer accorded superiority of fire at medium range over infantry (Part II, para. 51).²

Rapid firing is employed, in exceptional cases, at from 350—1,000 m. (381—1,090 yds.), formerly 300—800 (Part II, § 32).

The extension of the range at which fire is now opened, involves the condemnation of the teaching which lays particular stress on troops reserving their fire during an advance, until within short range of the enemy. The argument used by the supporters of this theory, that the effect of long-range fire is limited by the powers of vision, is set aside by the introduction of the following sentence into para. 130: "At long ranges the object to be fired at will occasionally be discernible only by means of field glasses, and will not therefore be seen by the men themselves. It will be necessary to indicate to them particular spots on the ground upon which to direct their fire."

Rules for Individual Fire in Action.—The following rule has been inserted (§ 133) as a guide to the individual soldier who may find himself thrown on his own resources in action, owing either to the confusion of battle or from lack of superiors to direct him—

To fire { at all objects up to 600 m.
 { only at large objects between 600—1,000 m. } (This is permissive,
Not to fire (as a rule) over 1,000 m. not obligatory.)

¹ *Probable Results of Firing* (Musketry Regulations, 1889, § 157).—When firing at low objects, good shooting may be counted on up to 600 m. (654 yds.), i.e., short ranges. Over 600 m. a considerable expenditure of ammunition will be required to produce any decisive effect. Large objects may still be fired at with good results between 600 m. and 1,000 m. (medium ranges). In comparison to the probable result, the expenditure in ammunition when firing at objects over 1,000 m. (long range) is very considerable. Only those objects, therefore, which, owing to their height and breadth, offer a large striking surface, should be fired at, at long ranges.

² Musketry Regulations (§ 72), 600—1,000 m. (654—1,090 yds.).

³ (*Musketry Regulations*, 1889, § 147.)—The soldier is taught that, if he handles his rifle correctly, he may expect the following results in firing up to 600 m. (654 yds.), namely:—

To hit all objects	up to 250 m. (272 yds.).
„ a single man kneeling	350 m. (381 yds.).
„ two men kneeling close together	500 m. (545 yds.).
„ „ standing	600 m. (654 yds.).
„ a single mounted man	600 m. (654 yds.).

Exclusion of Extraneous Matter.—The jealousy with which the contents of these Regulations have been restricted to their legitimate sphere, as marked out in the index, will be seen by the exclusion from Part II, § 52, of the detailed instructions as to the construction of shelter trenches, and the insertion of a note that they will be prepared in accordance with the Pioneer Regulations for infantry.

Colours.—Though so careful in excluding all extraneous matter from the Regulations which mould the manhood of the nation into trained bodies of fighting men, the Germans do not think it out of place to include in them detailed instructions for handling the colours. They are treated with the highest respect and are considered as a powerful lever for maintaining the morale of the soldier, who commences his career by taking the oath of allegiance on the colour with due ceremony. (See Footnote 1, Vol. XXXIII, Journal, 1889, No. 147, p. 259.) A whole page (§§ 45—49) is devoted to the "Manual with the Colours," in Part I, where space is so precious, and Part III contains two and a half pages on, "Fetching and Returning the Colours." But not satisfied with all this a new sub-paragraph has been added to Part I—paragraph 47 (covering a quarter of a page), further detailing how the colours are to be carried under certain circumstances.

Nationalization of Language.—The last point of interest to be remarked upon is the further "Germanizing" of the German language introduced in this new edition, of which the following two words are examples:—

Old word.

New word.

Figure.

Abbildung (figure on plates).

Atmosphäre.

Witterung.

Conclusion.—One year's mature deliberation and practical working of the Regulations, 1888, have left them practically unaltered, but for the modifications due to the introduction of the new arm. Nothing had been done in haste, and consequently nothing had to be undone. "Slow and sure," the motto of the tortoise, can no longer be regarded as descriptive of the German manner of dealing with their military concerns. Their new method of procedure may be more appropriately described as "deliberate and in due time."

APPENDIX I.

The introduction of the new Mauser small-bore is the fifth modification of the armament of the Prussian Army in a period of 50 years.

- i.e., { 1839 grooving introduced.
1841 needle gun introduced (issue completed in 1862).
1871 Mauser rifle introduced.
1884 Mauser rifle converted into a magazine rifle. "Infantry Rifle, 1871-84."

The following is the description of the new "Infantry Rifle, 1888":—

Length of rifle, 1.245 m. (4.07 ft.).

Weight of rifle, 3.8 kg. (8.36 lbs.).

Diameter of bore, 7.9 mm. (0.309 in.).

Rifling from left to right { 4 grooves.
1 turn in 24 cm. (9.42 in.).

Sighted to 2,050 m. (2,234 yds.).

Carries 3,800 m. (4,142 yds.) at 32° elevation.

562 ALTERATIONS IN GERMAN INFANTRY DRILL REGULATIONS.

Initial velocity averages 620 m. (2,027 ft.), at 25 m. ($27\frac{1}{4}$ yds.) from the muzzle.

Trajectory at 500 m. (545 yds.) the culminating point is 1·5 m. (4·9 ft.).

Average Rapidity of firing—18 shots a minute.

<i>Penetration</i>	<i>Wood</i> (dry fir)	At 100 m. (109 yds.)	80 cm. (31·4 in.).
		" 400 m. (436 yds.)	45 cm. (17·7 in.).
		" 800 m. (872 yds.)	25 cm. (9·8 in.).
		" 1,800 m. (1,962 yds.)	5 cm. (1·96 in.).
	<i>Steel plates</i> 8 mm. (0·31 in.) thick, are barely marked at 50 m. (54·5 yds.).		
<i>Sand</i> (freshly thrown up)	At 100 m. about	90 cm. (35·3 in.).	
	" 400 m. "	50 cm. (19·6 in.).	
	" 800 m. "	35 cm. (13·7 in.).	
	" 1,800 m. "	10 cm. (3·9 in.).	
<i>Earth</i> should not be of less thickness than 75 cm. (29·4 in.).			
Several shots striking on the same spot, pierce a <i>thin brick wall</i> .			

APPENDIX II.

Ammunition.

1. Packed in boxes containing:—

Cardboard cases.	Packets.	Metal frames.	Rounds.
5	=	75	= 225 = 1,125
1	=	15	= 45 = 225
		1	= 3 = 15
			1 = 5

2. Quantity carried per man:—

10 packets { containing { 30 frames.
 { weighing 5·03 kg. = 11·06 lbs.

3. Method of carrying:—

2 packets in each front pouch.
6 " the rear pouch.

4. Weights:—

Box	41·95 kg. = 92·29 lbs.
Case	7·75 " = 17·05 "
Packet	0·503 " = 1·1 "
Frame	0·155 " = 5·4 ozs.
Round	0·027 " = 0·95 "
Bullet	0·014 " = 0·49 "
Charge	0·002 " = 12·4 drs.

NOTICES OF BOOKS.

Practical Marine Surveying. By HARRY PHELPS, Ensign U.S.N. New York : John Wiley and Sons, 1889. Pp. 217. Size $9\frac{1}{2}'' \times 6'' \times 1''$. Weight under $1\frac{1}{2}$ lbs.

This is a useful text-book on Marine Surveying. As the author says in his preface, he "has attempted to cover all the points that may arise from the beginning to the end of a Marine Survey, and make the whole process as clear as it really is simple and straightforward." In this he has undoubtedly succeeded, and the student of hydrography will derive much assistance from a study of Mr. Phelps's book.—W.

Aide-Mémoire de l'Officier de Marine. Par É. DURASSIER. 4me Année, 1890. Paris : Baudoin and Co. Pp. 595. Size $6\frac{3}{4}'' \times 4\frac{1}{4}'' \times 1\frac{1}{4}''$. Weight under 14 oz. Price 3 fr. 50 c.

This book contains a great amount of information on naval matters of all countries.

Nautical Terms and Phrases in French and English. By Captain E. PICARD, French Navy, and Lieutenant SYDNEY FREMANTLE, Royal Navy. Portsmouth : Griffin, 1890. Pp. 165. Size $7\frac{1}{4}'' \times 4\frac{1}{2}'' \times \frac{1}{2}''$. Weight under $\frac{1}{2}$ lb. Price 3s. 6d.

This is a most useful publication. The terms, phrases, and other matter relating to the two navies are, in their respective languages, placed opposite each other either on the same page or on opposite pages. The contents have been obtained by conferences between the authors on board ship as well as elsewhere, and we congratulate them on the result.

Trial by Combat. By GEORGE NEILSON. Glasgow : Hodge and Co., 1890. Pp. 348. Size $7\frac{1}{2}'' \times 5\frac{1}{2}'' \times 1''$. Weight under 1 lb. Price 7s. 6d.

An account of the judicial duel in England and Scotland, and full of curious antiquarian details.

Three Decades of Volunteering, 1859-1889. By the ANCIENT. London : Trounce, 1889. Pp. 100. Size $7'' \times 4\frac{1}{2}'' \times \frac{1}{2}''$. Weight under $\frac{1}{2}$ lb. Price 2s.

An interesting sketch of the Volunteer movement, with special reference to its shooting side.

Istituzioni ed Esempi di Letteratura Militare. By Captain ROMANETTI. Second Edition. Turin : Roux, 1889. Pp. 380. Size $7\frac{1}{4}'' \times 5'' \times 1\frac{1}{4}''$. Weight under $1\frac{1}{4}$ lbs.

This is a work of the class containing Horne and Pierron, and will doubtless be very useful to those for whose use it is intended.

Perchè e Come si fa il Soldato. Libro pel Soldato Italiano. Pavia : Successori Bezzoni, 1889. Pp. 325. Size $7\frac{3}{4}'' \times 5\frac{1}{4}'' \times \frac{3}{4}''$. Weight under $\frac{1}{2}$ lb.

One of three works for which a prize was awarded by the Italian Government for "a book of military Education for the Italian soldier." It is, to a certain extent, historical as well as professional.

Oliver Cromwell the Protector: An Appreciation based on Contemporary Evidence.

By REGINALD F. D. PALGRAVE, C.B. London: Sampson Low, 1890. Pp. 320.

Size 8" x 6" x 1½". Weight under 1 lb. 14 oz. Price 10s. 6d.

Not only does this book come from an author of established reputation and position, but at the request of the Dixie Professor of Ecclesiastical History in the University of Cambridge, who is also the editor of the "English Historical Review," the author has dedicated it to him. The work must therefore be necessarily regarded as of high authority on the subject of which it treats. Mr. Palgrave at the outset states that his investigation discloses a Protector so utterly unlike the image which modern fancy has set up—a creature who "comes in such a questionable shape"—that he will deservedly be put to his purgation. A more bitter attack on Cromwell we have never read.

Historical Records of the XXXth Regiment. London: Clowes, 1887. Pp. 283.

Size 10" x 6½" x 1½". Weight under 1½ lbs. Price 12s.

Though published in 1887, this book has only just been sent us for notice. The record is very clearly drawn up, and, at first sight, we thought it was framed on lines which, if followed, would make our regimental histories invaluable; but in this hope we were somewhat disappointed. A regimental history should be something more than a record of times, places, names, and movements; it should contain stories of warfare valuable for instruction, and examples from the past which a corps can emulate in the future. The sixty pages containing a chronicle of the Waterloo campaign, contributed by Major Macready, are not only delightful reading, but give a picture of war as it really is. We wish that similar personal experience from other parts of the distinguished career of the XXXth had been given more fully than is the case. The book deserves to be read even for Major Macready's account alone.

The Brain of an Army. A Popular Account of the German General Staff. By

SPENSER WILKINSON. London: Macmillan, 1890. Pp. 115. Size 7½" x 5" x 1½".

Weight under 10 oz. Price 2s. 6d.

A very interesting account of the constitution and working of the German General Staff. We demur, however, to the monopoly implied in the title. The "motive power" would have been more appropriate, and less uncomplimentary to those who do not sport the cocked hat and feathers.

Journal of H.M.S. "Enterprise" on the Expedition in Search of Sir John Franklin's Ships by Behring Strait, 1850-55. By Captain RICHARD COLLINSON, C.B., R.N., Commander of the Expedition. With a Memoir of his other services. Edited by his brother, Major-General T. B. COLLINSON (Royal Engineers).

London: Sampson Low, 1889. Pp. 531. Size 8½" x 5½". Weight under 2 lbs. 6 oz. Price 14s.

The appropriateness of the motto affixed to the title-page—

"'Tis not in mortals to command success,
But we'll do more, Sempronius, we'll deserve it,"

is amply borne out by the contents of this volume. The notes, some ninety pages, drawn up by the editor, are most interesting, and the Memoir, from the same pen, is admirably written.

Captain Cook. By WALTER BESANT. Pp. 191. Weight under 12 oz. Size 7½" x 5¼" x ¾". Price 2s. 6d.

Lord Strafford. By H. D. TRAILL. Pp. 206. Weight under 12 oz. Size 7½" x 5¼" x ¾". Price 2s. 6d.

Peterborough. By W. STEBBING. Pp. 228. Size 7½" x 5¼" x ¾". Weight under 14 oz. Price 2s. 6d.

Three more valuable contributions to the series, English Men of Action; published by Messrs. Macmillan.

Victoria Cross, and How Won. By T. E. TOOMEY, late Colour-Sergeant 1st Batt., the Royal Irish. London: A. Boot and Son. Pp. 67. Weight under 6 oz. Price 5s.

A list of the recipients of the V.C., with analytical tables of the distribution among regiments, &c.

British War Medals, Military and Naval, and How they were Won. By THOMAS CARTER. London: Groombridge. Part I. Pamph. Pp. 80. Weight under 6 oz. Price 2s. 6d.

This work is illustrated with facsimile coloured plates and wood engravings, and both are excellent. It is to be completed in eight parts, and it gives an amount of information both valuable and interesting. We wish it every success.

The Crown Prince and the Imperial Crown. Reminiscences. By GUSTAV FREYTAG. Translated from the seventh edition of the German. By GEORGE DUNCAN, M.A. London: George Bell and Sons, 1890. Pp. 130. Size $7\frac{1}{4}'' \times 5'' \times \frac{3}{4}''$. Weight under $\frac{3}{4}$ lb. Price 4s. 6d.

This book contains much that is very interesting, and which comes first hand.

A Summary of the Drill and Working of the Three Arms. By Colonel H. J. HALLOWES. London: Clowes and Sons, 1890. Weight under 2 oz. Price 1s. 6d.

This is a small book of 104 pages, suitable to carry in the pocket, and was first published by the author in 1888, when A.A.G. Mhow Division. It has been twice revised, consequent on alterations in the infantry drill. The object is to enable "every Officer in the Army, of whatever rank or position, to be sufficiently acquainted with the drill of the three arms to recognize the formation of any body of men he may see, and to convey an intelligible order to branches of the Service other than his own." It may certainly be found very useful.

Analysis of the Rules for Reckoning Soldiers' Service, &c. By Major-General H. P. MONTGOMERY. Second Edition. London: Simpkin and Marshall, 1888. Pp. 82. Size $7\frac{1}{4}'' \times 5'' \times \frac{1}{4}''$. Weight under 8 oz. Price 2s.

The first edition being sold out, and the demand continuing, is the best proof of the value of this little book.

A Condensed Russian Grammar for the Use of Staff Officers and others. By F. FREETH. London: Trübner, 1886. Pp. 75. Size $7\frac{1}{4}'' \times 5'' \times \frac{1}{4}''$. Weight under 8 oz. Price 3s. 6d.

This is not intended as a grammar for young schoolboys. It presupposes a general knowledge of the grammar of some one other language.

Russian Conversation Grammar, with Exercises, Colloquial Phrases, and Extensive Russian-English Vocabulary. By ALEXANDER KINLOCH. London: Thacker and Co., 1890. Pp. 244. Size $7'' \times 4\frac{1}{4}'' \times \frac{3}{4}''$. Weight under 14 oz. Price 9s.

Mr. Kinloch was Interpreter to H.B.M. Consulate, and also Counsel for the British shipping in the Russian Law Courts, and is, therefore, well qualified to afford to students the aid which they will find in these pages.

Comment s'est Formé le Génie Militaire de Napoleon I^{er}? Par le Général PIERRON. Paris: Baudoin, 1889. Pamph. Pp. 39.

This pamphlet by General Pierron, the well-known indefatigable collector of the facts of military history, is well worth reading. General Pierron admits that in his youth he shared the idea, so prevalent in France, that the genius of Napoleon was innate in that great leader; a belief which has tended, with fatal results, to produce a contempt for profound study in the French Army. It was, however, known long ago that Napoleon was an earnest and hard-working student of war, and in 1866 General Berthaut struck, as he believed, on the clue to the secret of the success of Napoleon, finding "That the plan of the Campaign of 1796 had been

borrowed by him from Marshal de Maillebois, who carried on campaigns in Italy in 1745-46." General Pierron considers, and rightly, that the reputation of Napoleon as a commander is in no way diminished by the discovery that to real, hard study so much of his success was due.

Problems of Greater Britain. By the Right Hon. Sir C. W. DILKE, Bart. 2 vols. London: Macmillan, 1890. Pp. 1,214. Size 9" x 6 x 3 $\frac{1}{4}$ " Weight under 6 lb. Price 36s.

We could not, in the very limited space at our disposal, do anything like justice to this work. The problems it deals with extend to the remotest parts of the Empire; and, as there are few parts of that Empire where our Journal is not to be found in the hands of a member, we hope this brief notice of Sir C. Dilke's book may thus be brought to the notice of all who are, as citizens of Greater Britain, interested in the problems.

Historical Record of the Royal Welsh Fusiliers. Arranged by Major R. BROUGHTON-MAINWARING. London: Hatchards, 1889. Pp. 372. Size 9" x 6" x 1 $\frac{1}{2}$ ". Weight under 2 lbs. 6 oz. Price 7s. 6d.

Major Mainwaring has ably fulfilled the duty which he modestly terms "arranging" the records. His work is a continuation of that commenced by a predecessor.

Unsere Festungen. Von A. HENNING, Ingénieur-Hauptmann, z.D. Berlin: Balt, 1890. Pp. 212. Size 9 $\frac{1}{4}$ " x 7" x $\frac{3}{4}$ ". Weight under 1 lb. 4 oz.

This remarkable work aims at nothing less than an entire revolution in the accepted principles of Permanent Fortification. The author proposes to abandon the use of detached forts, and to return to a continuous "enceinte" with advanced works; his system has, nevertheless, no resemblance to any former trace, and is entirely original. He is a strong advocate for steel shields, which he desires to place for the protection of all heavy guns, and he suggests that the latter may have a calibre of 8 inches, which would probably imply a weight of about 12 tons. He shows, also, drawings of a variety of disappearing mountings, of which at least one will be found practically impossible.

But perhaps the weakest point in the book is, that the system proposed in it is not applicable to any existing fortress, but requires a new site for itself. The author, however, considers that one or two fortresses of his type would suffice for the protection of the whole of the German Empire; he further distinctly professes his adherence to the maxim that a Power which is rich in men can spend such money as is available for military purposes in a thousand better ways than in building fortresses.—N. L. W.

EXTRACT FROM THE BYE-LAWS.

Section II.—Composition.

1. Princes of the Blood Royal; Lords Lieutenant of Counties; Governors of Colonies and Dependencies; Officers of the Army, Navy, Marines, Her Majesty's East Indian Military and Naval Forces, Militia, Yeomanry, Royal Naval Reserve, and Volunteer Corps shall be entitled to become Members, *without ballot*, on payment of the Entrance Fee and Annual Subscription.

N.B. Any Officer coming within the above definition, who may wish to become a Member of the Institution, can do so by copying one of the subjoined Forms, and inclosing it to the Secretary:—

FORM FOR BECOMING AN ANNUAL SUBSCRIBER.

15

It is my desire to become a Member of the Royal United Service Institution; and I hereby request and authorise my Agents [or Bankers], Messrs. _____, to pay my Entrance Fee (£1) and Annual Subscription (£1) now, and as it becomes due on the 1st of January in each year, to the Secretary of the Institution.

Signature.

Qualification
for Membership.

FORM FOR BECOMING A LIFE SUBSCRIBER.

It is my desire to become a Life Member of the Royal United Service Institution; and I hereby authorise my Agents [or Bankers], Messrs. _____, to pay my Entrance Fee (£1) and Life Subscription (£9) to the Secretary of the Institution.

Signature.

Qualification
for Membership.

2. Ex-Governors of Colonies and Dependencies, Retired Officers, Deputy Lieutenants of Counties, Civil Functionaries who are or have been attached to the Naval and Military Departments, the Master, Deputy Master, and Elder Brethren of the Trinity House, and Army and Navy Agents, shall be *eligible* to become Members by *Ballot*.

3. Gentlemen above the age of *fifteen*, whose names are on the list of the Commander-in-Chief for Commissions in the Army, or who are probationary for offices connected with the Naval and Military Professions, shall be *admissible*, by *Ballot*, to become *PROVISIONAL MEMBERS* from year to year, on payment of the Annual Subscription; and after they obtain their appointments, they may become ordinary Members on payment of the Entrance Fee.

N.B. Members admissible by Ballot must be proposed and seconded by two Members of the Institution, and their names will be submitted to the Council for election. Ballot papers may be obtained at the Institution.

Form of Bequest.

I give and bequeath unto THE ROYAL UNITED SERVICE INSTITUTION,
situated in Whitehall Yard, London, the sum of

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designs of the said Institution, such Legacy to be paid out of such part of
any personal Estate not specifically bequeathed as the law permits to be
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THE COUNCIL of the ROYAL UNITED SERVICE INSTITUTION are desirous of obtaining the assistance of OFFICERS of the NAVAL and MILITARY SERVICES in carrying out the Courses of Lectures at the Institution.

Officers who will favour the Institution with a Lecture, or a Course of Lectures, are requested to communicate with the Secretary.

The Lectures, and the Discussions which follow them (or an Abstract of them), and Descriptions of Inventions, are published in the Journal of the Institution, subject to the discretion of the Council, and illustrated, when necessary, by Diagrams.

By order of the Council,

B. BURGESS, Captain,

Secretary.

